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ELECTRIC FEEDERS FOR MAIN-LINE RAILROADS.

At the International Railway Congress, recently held in Paris, Colonel N. H. Heft, chief engineer of the electrical department of the New York, New Haven & Hartford Railroad, presented a study of the conditions governing the electrical equipment of railroads in this country, and an account of the experiments already made in electric traction on a large scale. Colonel Heft's conclusions looked to the development of electrically operated branches in the larger cities and their suburbs as feeders for the main line system railways. He further believes that electric traction upon the densely populated portion of main line railways—that is, in the region of suburban trains—is not only a future possibility but an absolute present necessity.

It is pleasant to have the conclusions which have so frequently been set forth in these columns corroborated by records of real experience. The time has now come when suburban service, by which is meant passenger service covering moderately long distance at high speeds and with many stops, must be operated by electricity. The steam locomotive on such a railroad is an anachronism. It does not seem yet within the bounds of engineering practicability to construct electric systems for very long-distance lines, and for the operation of high-speed trains with few stops, that will show commercial results. Electricity has absolutely displaced every other variety of tractive force, however, for the working of street railroads or passenger carrying for very short distances at low speeds and with very frequent stops. It is rapidly taking its place as the sole agency in use for what may be called intermediate service, whereby passengers are transported at higher speeds to greater distances and with fewer but still relatively many stops. The next development of passenger transportation in which it is destined to become preeminent is that of express and local trains between cities separated by one hundred miles or less in crowded and densely populated sections. Take, for example, the whole stretch of country from New York to Boston on the one side, and New York and Philadelphia on the other. Here the density of population is as great as it is anywhere in the United States, and the vast commercial interests centred in these cities and the intermediate towns require a large amount of travel on the part of this population. There is a constant demand for better service, higher speeds and greater facilities, and the traveling public are quick to appreciate the railroad which gives it to them. On one side of New York competition between rival lines of railroads has resulted in a service of trains, a grade of rolling stock, a perfection of schedule and management, that is not surpassed anywhere else in the world. It is in some such place as this that we must look for the first application of electricity to the main line railroad, not only for the operation of feeders but for the working of the freight and passenger business on the railway itself.

The feeder lines must come because the competition of the trolley road has grown larger and more expensive to the steam railroads by leaps and bounds. Sooner or later the railroads must go into the trolley business or else put electric trains on their branches and suburban routes—unless they desire to give up the profitable passenger traffic for short hauls, which is now a considerable item in their revenue. It will not be long before we see the electrical equipment of a main line for the simple reason that the logic of the situation absolutely requires this to be done; and even railway managers sometimes move under the pressure of necessity.

THE PARIS EXPOSITION.

The Paris Exposition of 1900 has gotten along to that stage that the official awards have been made and the work of the judges completed. There seems nothing else to do now but to close what has been the least satisfactory exposition of its pretensions ever given. Of the various causes that have contributed to this result perhaps the most striking was a certain complication of the political situation in Europe, unnecessary to discuss here, and the unsatisfactory condition of affairs in France during the year preceding the opening of the exposition. While

it is true that these causes, and international jealousy, may have had a good deal to do with the failure of the exposition, it seems likely that the greatest contributing factor to the failure—for failure it was—of the exposition is due to the fact that such shows are being held so frequently that manufacturers are worn out with the trouble and expense of exhibiting at them.

For the manufacturer who contemplates making an exhibit there is only one course to pursue—he must spend money enough and time enough to make an exhibit of which he will be proud, and one that shall set forth, as well as possible, the resources and products of his establishment. There is no more expensive form of advertising known than this. The situation is complicated by the fact that out of the hosts of visitors to an exposition of great magnitude very few ever see or hear of individual exhibits unless these be on a gigantic scale, and the very persons who may be most important to the manufacturer possibly do not visit the exposition or see them at all. Hence the experience of many who have taken part in international shows of this kind is that the game is not worth the candle. The expense is necessarily large and the results disproportionately small. When, in addition to the expense of preparing an exhibit, shipping it to a long distance, showing it and having it attended and watched, and the preparation of circular matter in different languages, there come added expenses imposed by a short-sighted policy on the part of the exposition authorities, the result, from the manufacturer's point of view, is exceedingly disappointing.

That this was the case at Paris, no one who exhibited there can doubt for a moment. The fact is that people are very tired of international expositions. The Centennial of 1876 and the Paris Exposition of 1889 were visited for their merits and people went to them to see machinery and products which they had no opportunity to see or have described to them elsewhere. In 1893, at the World's Fair, in Chicago, was first introduced the frivolous side-show accompaniment which has reached development this year at Paris to such an extent that it forms practically the leading feature of the exposition. While this may make the show more attractive to the casual visitor, it certainly does not make it so valuable to the man who has spent money to prepare an elaborate exhibition of machinery or manufactured products. As a matter of fact, the technical journal, as we have pointed out before in these columns, is nowadays a continuous World's Fair and International Exhibition and has done more to instruct people interested in the various branches of technical work in new processes and products, and to bring together manufacturer and user, than all the expositions that have ever been held or that ever will be held.

THE STREET RAILWAY CONVENTION.

The coming convention of the American Street Railway Association, at Kansas City, October 16 to 19, will probably be the most important meeting in the history of that body. We Americans are peculiarly a convention-loving people. Possibly it is a reflection of our form of government into our daily affairs that we like to get together and talk things over and exchange ideas and to appoint committees, but whatever may be the cause of the convention spirit there can be no doubt that this practice, as exemplified in the great associations of street railway and electric light companies, has done an almost incalculable good for these developments of the electrical field. It is curious to reflect, when one considers how wholly to-day the Street Railway Association belongs to the electrical industry, that only ten years ago many of its deliberations concerned the care and treatment of horses, while fifteen years ago the very name of electricity was not mentioned at its sessions. We may justly take a kind of national pride in the development of the electric street railway because it is to all intents and purposes a product of our own inventive genius, and, to an equal degree, of our own financial courage. Probably nowhere else in the world could even so promising a thing as the electric railroad was ten or twelve years ago have received the loyal assistance of moneyed men and been backed by the vast sums necessary to insure its ultimate success. We should not forget, in reviewing the history of the electric railway in America, that, vast as is the credit belonging to the inventor and the engineer, no less is deserved by the financier and the capitalist, and even by the promoter, who have made its astonishing development something to which we can justly invite the admiring attention of the world.

On another page are shown some illustrations of electric lighting effects in the streets of San Francisco during a recent festival held in that city. The surpassing beauty of electric lighting decorations of this sort has made them rapidly popular, and now no great city demonstration, any part of which is held at night, is complete without this accessory. The subject of arranging and wiring decorative lights for outdoor and occasional use is one that, so far as we know, has not been thoroughly exploited. It is certainly a highly interesting development of electric lighting and one that seemingly should repay some little study on the part of engineers. The popularity of electric light decoration can not soon grow less on account of its beauty and the ease with which the electric lamp lends itself to decorative effects of whatever kind.

Even to the casual observer it was evident that a coal strike was in progress last week when the formerly smokeless city of New York became covered with dense clouds of black smoke, shot upward from a thousand chimneys that have done their work unnoticed for years past. New York has enjoyed a practically smokeless atmosphere for several years and when it is considered that it is the largest manufacturing city in the United States, and that the enormous total of steam power developed in it requires the daily consumption of vast quantities of coal, it will readily be understood what a difference is made when pitchy and smoky bituminous coal is substituted for the almost smokeless fuel that has been lately in use. At this writing the prospects for the immediate ending of the strike seem excellent, and, if for no other reason than that we desire to see the sun again and emerge from the murky atmosphere of the last few days, this consummation is one that we all devoutly wish for.

ON THE APPARENT EMISSION OF CATHODE RAYS FROM AN ELECTRODE AT ZERO POTENTIAL.*

BY CHARLES E. S. PHILLIPS.

It has been noticed by many people who work with X-ray or other vacuum bulbs that numerous bright green patches occasionally appear upon the inner surface of the glass walls of a bulb while a discharge is passing, especially during the process of exhaustion. These green flecks vary considerably, from time to time, both in shape as well as in position, and efforts have been made to connect their existence either with want of uniformity in the composition of the glass or with irregularities in the surface of the negative electrode.

I have already, in another place, given some account of an experiment made with the object of clearing up this uncertainty, and now beg to supplement that work with the following observations as to the cause of the phenomenon. The experiment just referred to consisted in using a pivoted disk of aluminum as the negative electrode in a bulb containing rarefied air, so that when green patches appeared a rotational movement of the disk (actuated by means of an external magnet) would show whether the patches of green moved in a corresponding manner or not. It was seen that they did so move. A distinct feature of the experiment, however, consisted in ascertaining whether those flecks which persisted after the discharge had ceased were still sensitive to movements of the cathode. This also was found to be the case. The proof, therefore, that the green patches were associated with an emission from the cathode appeared complete. But it was further noticed that subsequent to the passage of a discharge, and even when either or both of the electrodes were connected to earth, still the green flecks were easily visible upon the glass walls of the bulb, and continued to move as before, when the cathode was rotated. This was apparently a case in which cathode rays were emitted from an electrode at zero potential.

I do not know that any explanation of this effect has so far been offered, and I therefore venture to bring forward the following suggestions, supported by further experiments. When a piece of metal is placed in a rarefied atmosphere and made the negative pole for an electrical discharge passing across the attenuated gas, innumerable small, bright specks of light appear over the surface of the metal. It was found convenient in my particular case to use an iron electrode for observations of this effect, because it had the advantage of being readily magnetizable from without. The addition of a similar iron electrode to act as the anode determined the shape of the magnetic field. With such an apparatus it could be seen that the bright spots appeared principally upon the cathode while the discharge passed, and that the creation of a magnetic field between the electrodes made visible the individual luminous streams of gas emanating from those tiny points of light. The paths of these luminous streams, becoming bent by the action of the magnetic field, followed the direction of the lines of magnetic force and exhibited a tendency to become spiral in accordance with well-known laws. In this way a fine layer of sodium upon the anode was caused to fluoresce through the action of the negatively electrified particles beating down upon it. One was able, in fact, by this means to cast shadows of objects placed in the paths of the bent streams, and at a pressure considerably higher than that necessary for the production of the well-known cathode shadow effects. In the above case, however, the method served to clearly establish the fact that the bright points of light upon the surface of the cathode indicated the places from which the jets of gas originated. The number of these jets became less as the exhaustion was continued, and individual streams were very clearly seen owing to the action of the magnetic field. When the discharge began to cause fluorescence in the glass of the bulb some green patches made their appearance, and, in some cases when the cathode was magnetized, a bright spot, which was previously judged to indicate the origin of a green patch upon the glass, would shift to a new position upon the electrode. In all such cases the corresponding patch also moved in a similar manner upon the glass. At sufficiently high exhaustions the bright spots upon the electrode disappeared entirely, although green flecks were still visible upon the glass. But a movement as before of the electrode, as well as its magnetization, gave results consistent with previous observations. Under these conditions, when the discharge through the bulb was stopped, green flecks were still visible for about 10 seconds. A positively-charged body was brought up to the outside of the bulb and the patches brightened considerably. A negative charge similarly placed extinguished the flecks completely. This was also the case when the electrodes were connected to earth. Finally, vacuum bulbs, such as X-ray lamps, etc., exhibing green flecks while in operation, were generally found to deteriorate if laid aside for a month or two, owing to an increase in the pressure of the contained gas. We see, therefore, that, in the first place, the bright points of light upon the surface of the cathode are due to the emission of fine jets of gas; also that such jets, if negatively charged, may be made to cast shadows of objects suitably placed in their paths. It is at the same time clear that the green flecks referred to above are due, during the passage of a discharge, to these same jets of gas impinging upon the inner side of the glass walls, and that, under the conditions existing immediately subsequent to the passage of the discharge, it is evident that streams of gas continue to be emitted from the pores of the electrodes. In spite of the fact that with the electrodes connected to earth these streams consist of unelectrified particles, they assume that property of ionization during their passage across the space within the bulb which appears to be essential to the production of local fluorescence in the glass upon which they impinge.

This latter effect, while explaining the process by which a cathode emission may appear to originate at an electrode with no electrical charge upon it, is one to which I wish to draw especial attention, for there is reason to believe that the upper limit of speed for the individual particles constituting the jets can not exceed the rate at which sound is propagated. It is, therefore, interesting to find that, under such circumstances, fluorescence was produced in the glass upon which the streams impinged. As many of the observations referred to here were made during the course of an investigation into the diselectrifying action of magnetism now being carried out by myself at the Davy-Faraday Laboratory of the Royal Institution, I desire to express my indebtedness to the managers of that institution for the facilities which they have kindly placed at my disposal.

*Abstract of a paper read before Section A of the British Association, at Bradford, England.

The Toledo, Ohio, Fostoria & Findlay Electric Railway Company has given a contract to the Dover Construction Company, of Canal Dover, for building and equipping the road between Fostoria and Findlay, and work on the power house and grading will be started within two weeks. The construction company is under bond to have the road in operation July 1, and the work on the Toledo division will be begun on the completion of the other. The company is capitalized at a million and a half and will build entirely on private right-of-way.

Notes from the Paris Exposition.

Various Exhibits in the French and German Sections—The United States Historical Exhibit—Lord Kelvin's Instruments—Electrolytic Tubing—Accumulators.

BY C. L. DURAND.

On the second floor of the Electrical Palace is the exhibit of the Société Francaise d' Electro-Metallurgie, one of the most important of the French establishments for the manufacture of copper in divers forms by the electrolytic process. The general appearance of the exhibit is seen in Fig. 1. The works of this company, situated at Dines Sur Mer, cover a large extent of ground. The main electrolytic room, 300 feet long by 180 feet wide is almost completely filled by a series of electrolytic vats, designed mainly for the production of copper tubes and bars. These are formed by the Elmore process, which, as is well known, forms a solid and homogeneous deposit of copper by rubbing a hard body over the surface during the operation. The original method of Elmore has been taken up in France by M. Secretan, and brought to a practical working in the new establishment.

The exhibit is intended to show the different forms of copper which may be made successfully by this process. In the front of the exhibit are a number of rods of different sections. In the rear is a series of copper tubes, the largest being about one foot in diameter. On each side is a pillar formed by an assemblage of copper tubes from three to four inches in diameter. The largest of the tubes shown here has a diameter of four feet eight inches and a thickness of 1.2 inch; it is about 20 feet long, and weighs 1,220 pounds.

In the German section of the Metallurgical Palace is another exhibit of copper produced by the electrolytic method. This exhibit has been made by the Elmore Actiengesellschaft, one of the largest of the German electrolytic metal works; it is shown in Fig. 2. One of the new processes brought out by this company is the method of forming a deposit of copper, hard and quite homogeneous, upon the surface of steel, so that in this way a cylinder, for instance, may be formed, whose interior tube is of steel, but having a layer of one-quarter to one-half inch of copper upon the surface. This furnishes a roller of great solidity, and is of great advantage wherever copper rollers are needed, as, for instance, in different kinds of printing or embossing work, etc. These cylinders are made with steel journals which project from the central core. A number of such cylinders will be noted in the centre of the exhibit; those at the bottom are about seven inches in diameter; at the top are two larger cylinders of the same kind measuring nearly two feet in diameter. At the side of the exhibit will be noted a series of copper tubes of unusual size; these have a diameter of 14 inches and are 20 feet long. At the top of the exhibit are also a number of long tubes, but of smaller diameter, they are supported by a copper pillar at each end. In front is a collection of one and two-inch tubes and sections of larger diameter. An interesting specimen is that of the copper tubulure shown in front; this illustrates a new process invented by Herr Barthels, a German metallurgist; the tubulures are made with four or more branches, entirely in one piece. In the rear of the exhibit are specimens showing tubes of large diameter; these are probably the largest made at present by the electrolytic process. One of these measures six feet six inches in diameter; the specimen shown is about seven feet long, and weighs 225 pounds.

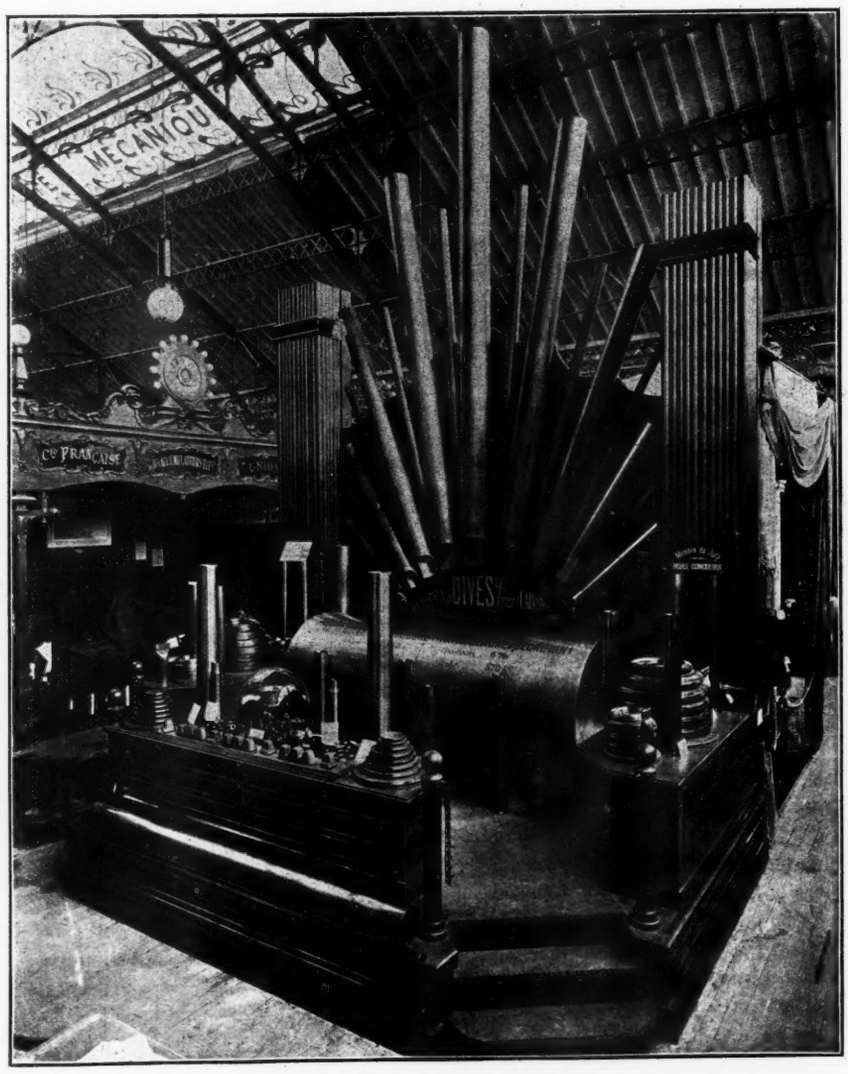


FIG. 1.—EXHIBIT OF THE SOCIÉTÉ FRANÇAISE D'ELECTRO METALLURGIE AT THE PARIS EXPOSITION, SHOWING ELECTROLYTIC COPPER TUBING.

Among the exhibits on the second floor of the Electrical Palace, that of the Chlor-

ide Electrical Storage Syndicate occupies a prominent place. The general appearance of the exhibit, which is in the British section, will be seen in the engraving. On one side has been erected a pavilion of tasteful construction, which serves for office purposes; opposite to this is the main portion of the exhibit, in which it is intended to show the various forms of accumulator made by the company. It should be stated that the fundamental principal of this type of battery consists in the use of chloride of lead in the composition of the plates. The positive plate consists of a solid lead plate, pierced with a number of hexagonal holes of rather large size; these openings are filled with chloride of lead by a special process, and this is reduced by electrolysis to spongy lead. The positive plate was at first made by again transforming the spongy lead to peroxide by electrolysis, but this method has been replaced by an improved process, which consists of filling the perforations, which are round in this case, with small spirals of twisted lead, fixed in place by hydraulic pressure. By an electric process the spirals are covered with a thin crystalline layer of peroxide of lead.

These cells are now made in all sizes and forms. To the right of the exhibit is a standard battery rack, on which are mounted three tiers of cells ten in each row; the 30 cells thus arranged give 60 volts, and their capacity is 300 ampere-hours, or 33 amperes on a nine-hours' discharge. The chloride battery is now used quite extensively in central station work, and various types of cell are shown, which are especially adapted for this purpose; they are usually contained in a lead tank; one of the largest of these tank cells is shown on the left, and near it are a number of smaller cells of the same kind; the large cell has a capacity of 6,864 ampere-hours, on a nine-hour discharge. A number of cells used for train lighting are to be seen; one of these is of the type used on the London & Northwestern Railway and another type is supplied to the London, Brighton & South Coast Railway. Another type of cell is that made for traction work; a number of these are shown in the exhibit, also a set of 12 cells in a flat box, of the type used on the Birmingham electric roads; one of these has been in use on this line for over six years. The cells used for automobile work are represented by a case containing 40 cells, connected to give 80 volts. The different forms of battery used for yacht and ship lighting are also represented; some of these are in glass cells, and others in lead tanks. Among those of interest are the cells supplied to Queen Victoria's private yacht, the Albert and Victoria, also to the yacht Osborne belonging to the Prince of Wales; a small portable battery of the kind supplied to the British navy, and others. At one end of the exhibit is shown a number of details to illustrate the manufacture of the plates, showing the method of inserting the spirals, the form of the positive and negative plates, etc. Besides this, there are a number of instruments for battery testing. Another prominent exhibit in the British section is that of the measuring instruments for laboratory and station use designed by Lord Kelvin and constructed by James White, of Glasgow. This exhibit, which contains many different types of instruments, is of especial interest. In the front of the illustration will be noticed four of the well-known balances designed by Lord Kelvin; in these no special novelty has been introduced lately; on the right is a centiampere

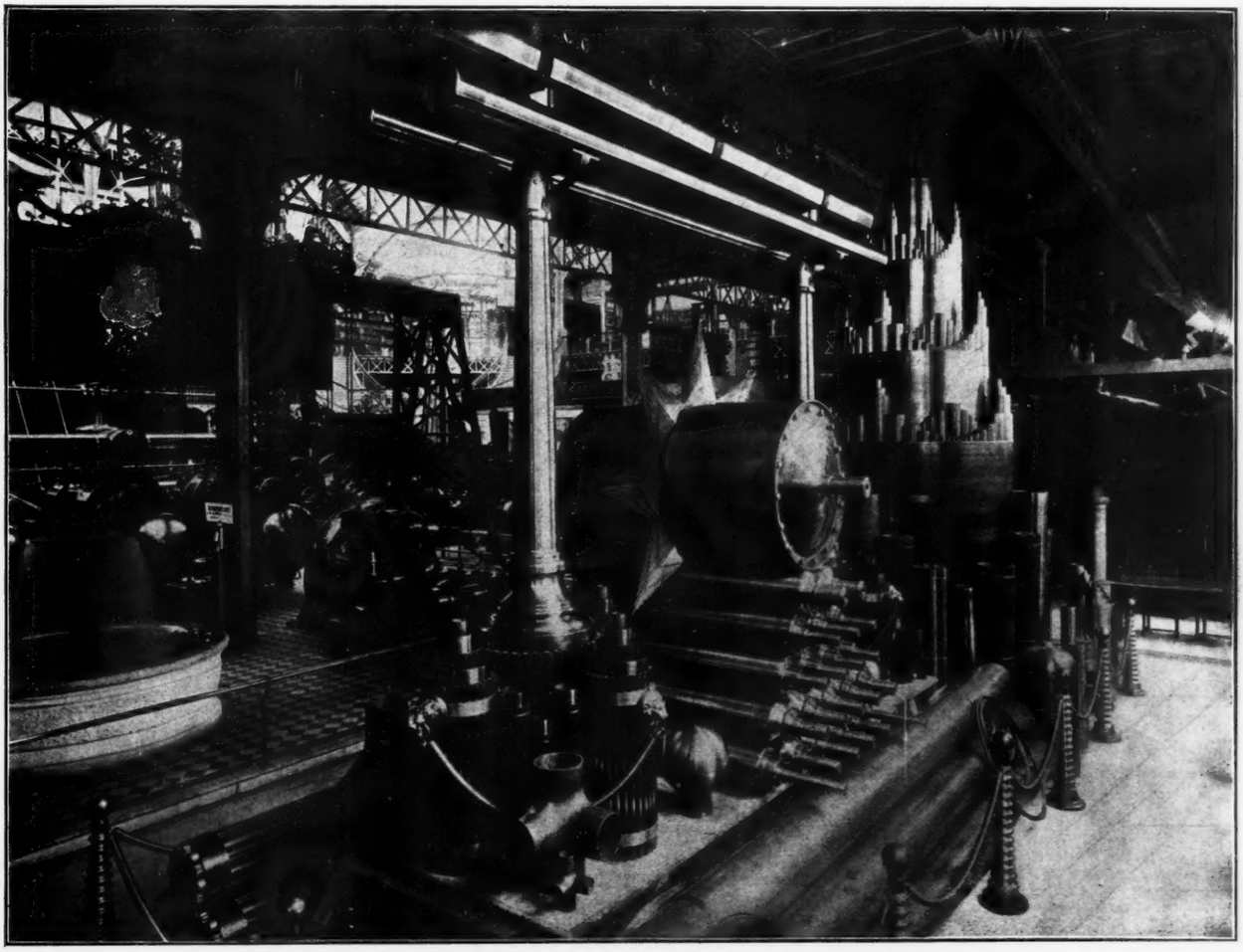


FIG. 2.—A GERMAN EXHIBIT OF ELECTROLYTIC COPPER AT THE PARIS EXPOSITION.

balance and a watt balance for currents up to 100 amperes. Between these two instruments is an astatic reflecting galvanometer; on the other side is a standard 25-ampere balance and a deka-ampere balance, and in the middle a static voltmeter of the multicellular type, which reads to 240 volts directly on the scale, and by placing resistances in series the reading of the instruments is multiplied, and 480, 960 volts, etc., may be read on the same scale. The box containing the resistances is made separate, and is of circular form, being adapted to be placed upon the top

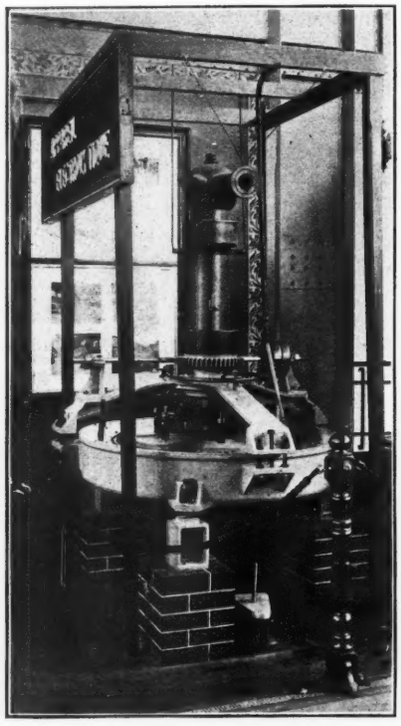


FIG. 3.—ELECTROLYTIC SODA AND CHLORINE VAT, EXHIBITED AT PARIS EXPOSITION.

of the instrument; it has a circular switch, with a series of contact points.

In the centre of the exhibit is a space enclosed by four panels, upon which have been placed a number of instruments, most of which are for station use. One of the newly designed instruments is the static recording voltmeter. It is contained in an iron box, divided into two compartments; in the upper is the voltmeter proper, and in the lower is the clock-work and registering drum. The fixed coils of the instrument are carried on a light gun-metal bracket attached to the frame and are well-insulated from it. The movable coils are arranged astatically on a light aluminum frame, to which are fixed the knife edges which support it at the front and rear and the aluminum rod for carrying the recording pen, which passes down to the drum through an opening in the box. The movable coils are in series with the fixed coils and a large non-inductive resistance; in this form of instrument incandescent lamps are used to form the resistance; the current is not sufficient to heat them to any extent and they remain permanent. The proportion of lamp resistance to that of the copper coils is so arranged that there is no appreciable error due to temperature. Below is a drum actuated by clockwork; it is arranged so that it can be lowered to a convenient position when it is desired to change the registering paper. The instrument is correct for any number of periods and for all the usual types of alternators; it will make a record for 12 or 24 hours. The voltage used may vary from 70 to 250 volts.

Another newly designed instrument is a three-phase wattmeter. This instrument has two sets of series coils, one behind the other, and in the centre are the corresponding shunt coils; these are coupled together and form the movable system. To the outer end is attached the pointer which indicates directly upon a graduated scale below. For pressures up to 250 volts, a resistance is placed inside the instrument which is in series with the shunt coils; but for high pressures, two separate resistances are used, one for each circuit; for these two terminals are provided at the back of the instrument. The most remarkable feature of this instrument is the form of suspension, instead of using pivots or knife edges, the movable part is suspended by means of a coiled spring of manganese bronze; the axis is attached to the centre of the spiral, the latter being hung by its free end. This form of suspension has been recently devised by Lord Kelvin, and is claimed to be superior to the other forms, doing away with friction; the current passing in the spring is not sufficient to cause any appreciable effect. In these instruments the insulation is tested to withstand alternating current of twice the normal voltage. This type of wattmeter is made for currents up to 200 amperes and voltages from 200 to 2,500. A portable instrument is made on somewhat the same principle, except that the spring suspension is replaced by a vertical torsion ribbon. The instrument is fitted in a bronzed brass case, with adjusting screws for leveling.

The dial instrument also uses the new type of spring suspension; it is made somewhat on the same principle as a d'Arsonval or Weston voltmeter. It has a movable coil surrounding a fixed core. To the end of the coil is fixed the inner end of the spiral, which is in turn supported upon an arm which passes below the coil and is bent up in front. Another new instrument is an ampere gauge in which the working solenoid is made up of a series of concentric coils of special construction; by this arrangement a very intense and uniform field is obtained, and the instrument has an almost equal division of the scale, it is unaffected by external fields, and is free from frictional errors; the error due to hysteresis is reduced to a minimum in this instrument. These ampere gauges are made from 5 up to 1,000 amperes.

A number of electrostatic voltmeters, nearly all of the multicellular type, are to be seen. One of these is arranged for station use, with a circular brass case and horizontal scale. The needle is of aluminum, in the form of two segments of a circle joined at their centres; its axis is horizontal, and it moves between a pair

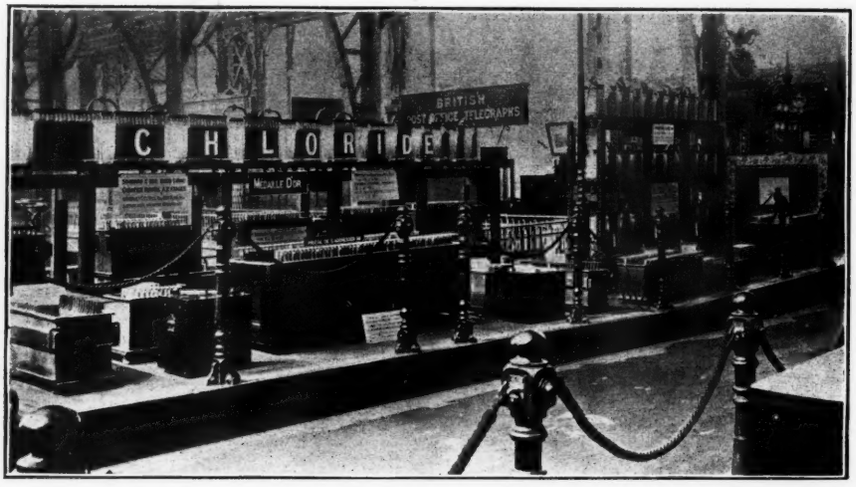


FIG. 4.—EXHIBIT OF THE CHLORIDE ELECTRICAL STORAGE SYNDICATE AT THE PARIS EXPOSITION.

of quadrants on each side. In this instrument there are four such needles and four sets of quadrants. At the outer end of the axis is carried the needle, which moves over the scale placed above. The reading is from 1,800 to 2,200 volts. The exhibit is in charge of Mr. Sam B. Wilson.

UNITED STATES PAVILION AND HISTORIC EXHIBITS.

The pavilion erected by the United States occupies a prominent place in the Electrical Palace. It was designed to contain the collection of historic instruments and apparatus which show the development of American electrical inventions. The pavilion is situated on the second floor of the Electrical Palace on the side next the foreign dynamo room. Fig. 6 gives a good idea of its exterior appearance. It is constructed entirely in white staff, the only color used being a band of green in the cornice above, having upon it a row of silvered projections. At the top is an ornamental scroll work supporting a row of candelabra; there are, besides, a number of larger candelabra formed by a figure holding three lamps, as will be noticed; the lamps have opal globes, and the effect of the whole is quite ornamental. There is an arched doorway in the centre, surmounted by a shield in colors and the American eagle; the two side arches of similar design, give passage through the pavilion by a hall on each side. On either side of the arches is a niche containing a figure, the latter are tinted in green. The main portion of the pavilion consists of a central room, round in shape, from which branch four corner rooms; there is, besides, a transverse passage which gives access to the central room from the side.

The appearance of the central portion will be seen in the second illustration, in which the details of the design and the ornamentation are clearly shown. Eight arches open out of this space; each of these is handsomely ornamented with figures in relief, and has on each side a pilaster of Corinthian style. Between the pilasters is a niche containing an allegorical figure. The cases in this room are devoted mainly to the work of Professor Henry; this is shown by a number of photographs of the apparatus used by him in his early experiments; among others are the flat copper spirals used in the detection and study of induced currents, the spirals were insulated by windings of black silk. Another photograph shows the large electromagnet made by Henry, at Princeton, in 1833; it was called "Big Ben" by the students on account of its strength, as it could lift a weight of 3,600 pounds. A view of the Sturgeon magnet is also shown, as it existed when Henry took up the subject in 1828.

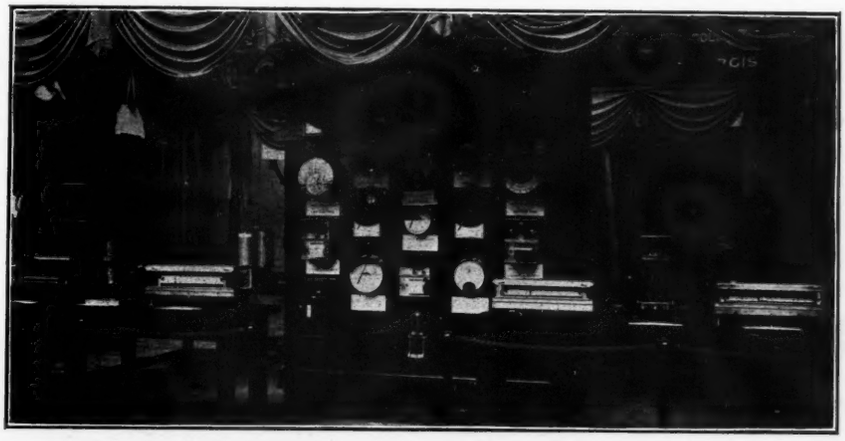


FIG. 5.- EXHIBIT OF LORD KELVIN'S INSTRUMENTS AT THE PARIS EXPOSITION.

A number of photographs show the electromagnetic railroad of Moses G. Farmer, this being the first car which was electrically driven; it was first run over an experimental track at Dover, N. H., in 1847. A portrait of the inventor and views of the car are shown. A number of cases placed in the different rooms contain a large collection of historic apparatus. The heavier pieces are placed in the large room on one side of the pavilion. In Fig. 7 will be seen the original electric locomotive built by Edison and operated at Menlo Park during 1880-1881. The first road was about a mile in length, but this was afterwards increased to three miles. The locomotive drew a freight car and two passenger cars. The first trip over this road was made on the thirteenth of May, 1880, in which seven passengers were carried. In later trips the locomotive often drew 40 or more passengers at speeds varying from 25 to 30 miles an hour, and speeds of 42 miles were sometimes made. Over 5,000 passengers and considerable freight were carried over this first road. It was narrow gauge, and the rails were laid on rough ties, and often on the top of the ground. The line was purposely laid out with sharp curves and steep grades to afford practice. A number of photographs show the appearance of this railroad and train. As will be observed, the locomotive has a pair of large front wheels and two smaller hind wheels, with the motor suspended in the middle; its armature is mounted on separate bearings and it has a pulley on the left from which a belt passed to a large pulley mounted on a separate shaft in the rear; on this shaft was also mounted a smaller pulley, whose belt passed again to the front and drove the front axle by a second pulley. To the right may be seen a part of the belt-tightener used. The current was taken from the rails, as is shown by a diagram of the electrical connections; the fields were placed either in series or parallel. The speed was controlled by an arrangement of plug resistance boxes in series with the armature.

FIG. 6.—UNITED STATES PAVILION AND HISTORICAL EXHIBITS, ELECTRICAL SECTION, THE PARIS EXPOSITION.

In front of the locomotive may be seen the different gear wheels which were used in the experiments.

In the rear of the locomotive is an Edison dynamo, the first that was installed on board ship in the United States. It was installed in the steamship Columbia, of the Portland & Oregon Navigation Company in 1882. This dynamo has been loaned by the General Electric Company. A number of early forms of controller and other apparatus are shown. In the same space are a number of photographs illustrating the development of electric railway apparatus as designed by Sidney H. Short, from 1885 to the present time. The photographs show motors and trucks in different stages of development, also the present improved types; the construction of the large generators is also shown.

In the same space is to be seen the original car designed and operated by Sidney H. Short, in Denver, Colo. The photograph shows the appearance of this car; it has four wheels, the motor drives the axle by simple reduction gearing. The motor is of the ordinary upright type, and is suspended by straps from the truck. This car was first operated on the sixteenth of May, 1885. It weighs about 1,600 pounds. The controlling device, of a primitive character, was placed in front; in the rear is a step by which the interior is reached; it has two seats running along either side. The current was taken by rubbing contacts from wires laid along between the rails. To the left of the illustration is a model of Franklin's electrical machine; the original was presented to the Franklin Institute by Dr. I. R. Coxe. The present model was made by the pupils of the Spring Garden Institute, of Philadelphia. The machine consists of a glass globe mounted upon an axis; at one side it carries a pulley, which passes below to a large wheel carrying the crank. The charge is collected by a comb formed of a brass rod, suspended horizontally, from which hang four copper wires in front of the globe. The rubber is placed underneath.

PERSONAL.

Mr. George Cutter, the electrical specialty and supply dealer, of Chicago, visited New York city last week.

Mr. Fred A. Larkin, New York manager of the Edward P. Allis Company, of Milwaukee, Wis., and Mr. M. G. Starrett, chief engineer of the Metropolitan Street Railway Company, of New York, have gone to Maine to spend a two-weeks' vacation in hunting.

Mr. and Mrs. Nixon, of Hyde Park, Canada, announce the marriage of their daughter, Kathleen Mortimore, to Mr. James Fuller Cummings, at St. George's Church, Bloomsbury, London, England, on August 23. Mr. Cummings is very well known in the electrical field as an expert in underground electrical construction, and his many friends will doubtless join the ELECTRICAL REVIEW in extending their congratulations.

A NEW METHOD OF STARTING THREE-PHASE INDUCTION MOTORS.

BY W. G. RHODES.

[*From the London Electrical Review.*]

The ELECTRICAL REVIEW, New York, for August 15, 1900, contains a description of a new method of starting three-phase induction motors, due to Herr J. Fischer-Hinnen, and employed by the Krizik establishment in Prague.

The method consists in, instead of using the ordinary non-inductive resistances in the rotor circuits, inserting a parallel arrangement in each rotor circuit, one branch of which is a non-inductive resistance, while the other branch has small resistance and large inductance.

It is stated that at the moment of starting, the coil of large inductance acts in all respects like a very high resistance, and the coils act together in much the same way as would two large resistances in parallel. As the speed increases and the frequency in the secondary circuit diminishes the apparent resistance of the inductive coil diminishes and the large ohmic resistance is thus shunted by an apparent resistance of constantly decreasing magnitude. Finally, when full speed is attained, the total apparent resistance of the starting system is sensibly equal to the ohmic resistance of the inductance coil.

The only advantage of this starting arrangement appears to be the avoidance of cutting out the starting arrangement after full speed is attained. The apparent resistance and inductance of the parallel arrangement are given respectively by:

$$R = \frac{\omega^2 L_2^2}{R_1}$$

$$\omega L = \frac{R_1^2}{\omega^2 L_2}$$

where $\omega = 2 \pi n$, n being the frequency of the rotor currents,

L_2 = the self-induction of the inductance coil,

R_1 = the resistance of the non-inductive coil.

This result is obtained on the assumption that the ohmic resistance of the inductance coil and the self-induction of the non-inductive resistance are negligibly small.

From this it would appear that a further displacement of the rotor currents behind the induced rotor electro-motive forces of an angle δ, would take place, where δ is given by

$$\tan \delta = \frac{R_1^3}{\omega^4 L_2^3}$$

Now R_1 is constant and fairly large, while ω diminishes as the speed increases. The value of δ would thus be greatest when the speed of the rotor is a maximum. At any period of the motion there is an increased lag of the rotor currents behind their corresponding electro-motive forces which has a deleterious effect, not only in decreasing the starting torque, but in decreasing the power factor of the motor at all times.

The method should not produce results as good as can be obtained by the use of a non-inductive resistance alone.

It is obviously an advantage if a starting arrangement can be used, which practically cuts itself out automatically as the motor runs up to speed, but I venture to think that this advantage is more than balanced by the disadvantage of a diminished power factor and a diminished starting torque.

Another American Underground Railway in London.

A cable despatch from London, dated September 29, says that Mr. Charles T. Yerkes, the American surface railway magnate, has closed his deal for the purchase of the franchise of an underground railway running from Charing Cross to North London, and has been elected chairman of the company which will construct the road. The English company now passes into American hands. The close of the negotiations is welcomed as proving that the much-needed connection of north and central London, which was projected seven years ago, will soon be a reality. The prospective patronage points to immense success for the road. A similar line which was recently opened from the Bank of England to Shepherd's Bush is proving very successful. Its trains frequently start from the termini so full of passengers that they are unable to take on board the persons waiting at intermediate stations. The company, therefore, is initiating a two and one-half minute service instead of a three and one-half minute headway as at present, and will attach an extra car to each train.

The new road will be equipped with all the latest improvements in electric transit.

A million dollar mortgage has been filed at Newark, Ohio, by the Columbus, Buckeye Lake & Newark Electric Railway in favor of the New York Knickerbocker Trust Company. Fifteen miles of the 40 between Newark and Columbus have been graded and the electrical machinery ordered. The company will establish a fine park at Buckeye Lake, formerly called the Licking Reservoir.

ELECTRICAL CONTACTS.*

BY FRANK C. MASON.

It is curious that the subject of electrical contacts has received so little attention in the literature and discussions of the general subject of electrical application. At the basis of nearly every variety of electrical apparatus, whether for signaling with small currents, or for the larger work of heating, lighting, generating and developing electric power and the application of electricity to chemical processes, the contact or point of discontinuity in the circuit is found as an essential part of the apparatus or of the method.

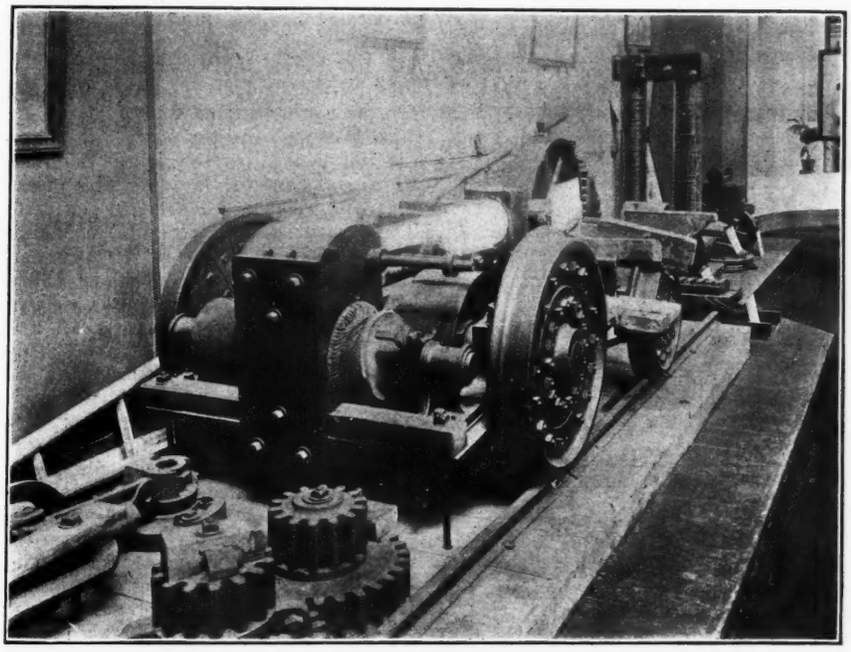


FIG. 7.—THE ORIGINAL EDISON LOCOMOTIVE, EXHIBITED AT THE PARIS EXPOSITION.

It is well, at this point, to say that this paper will be limited to those uses of electricity employing relatively small currents, as in telephony, telegraphy and signaling, and will not touch on the larger field that its subject embraces in the utilization of heavy currents. However, the line of demarcation between the light current and the heavy current is now by no means so sharply drawn as it was in the days when the primary battery, in one form or another, was the sole dependence of the telephone and telegraph engineer. When we see the dynamotor and the storage battery used as the central source of energy for a telegraph, fire-alarm and telephone system, we naturally wonder for how long we can speak of the light current applications of electricity as a distinction from those employing large and powerful currents generated by dynamos.

Contacts may be roughly grouped into three classes: those that are intended to be permanent (such as joints in wire and cables); those that are semi-permanent (such as contact between wire and binding-posts) and operative contacts, or those that are intended to be opened and closed at will, as in keys, switches, etc.

To all these kinds of junctions, two enemies exist constantly tending to destroy efficient electrical contact—chemical action and dirt. It is scarcely necessary to speak of mechanical strains, which are guarded against naturally by the exercise of common sense. Chemical action, as it applies to contacts, is generally due to the remnants of some compound or chemical used in soldering, and to the action of air and moisture (either singly or in conjunction), producing oxidation of the surfaces in contact. This action is enormously enhanced by the formation of sparks at contacts of the operative kind, the resultant film of oxide being generally a non-conductor and interfering greatly with the operation of the contact. Dirt, as Emerson says, is merely "matter out of place." In electrical work, dirt means any non-conducting substance that interferes with good electrical contact. It is often dust, but, in operative contacts, is more frequently the products of oxidation of the points of contact themselves, where (as is too often the case) these are of the baser and more oxidizable metals.

Permanent joints, or contacts, are used both in line conductors and in instruments. Nowadays, the general introduction of hard-drawn copper wire for overhead line work has reduced practice in this kind of jointure to a question of the best way to handle that material. Experience has shown that soldering such joints draws the temper of the wire, making a point of mechanical weakness, while the ancient habit of linemen of twisting the wire at the joint into tight spirals, leads to the same result. For these reasons, the twisted and soldered joint must necessarily give way to one of the various and excellent types of tubular joint now manufactured for the purpose. In cable work, especially, where paper insulation is used, the best practice now, strangely enough, is to use merely the twisted joint without solder. The wire being soft and subject to no strains the joint is abundantly strong, while its sheathing, after jointing fully protects it from the harmful action of the atmosphere and moisture. To solder such a joint would add the danger of corrosion from the dissolving action and slow electrolysis of the fluxes used.

Permanent joints, in switchboards and instruments, being protected from the weather are generally soldered. The wires used should be tinned, so as to leave no excuse for the use of the mischief-making chemicals sold as "soldering solutions." Tubular solder, having rosin or stearine flux in its hollow part should be used, and the utmost watchfulness employed to keep acid and "salts" away from the work. One easy joint made by these means may plant the seeds of trouble to be reaped later and, by the peculiar provision of fate, almost invariably just when trouble or break-down is most to be feared.

Semi-permanent contacts are, practically, of only two kinds, binding-posts and fuses. The average American binding-post is a piece of metal with a hole drilled through to receive the wire and another drilled and tapped to receive a set-screw, which may or may not have a pointed end. The design of this type of binding-post is utterly vicious. The screw may shear the wire nearly in two, leaving it so that the slightest strain will break it off, or it may not come down to a tight bearing on the wire, leaving a loose joint ready to collect dirt and become inoperative. Much the better type is that variety of binding-post in which the wire is firmly held between two flat surfaces, thus ensuring a large area of contact, and which is provided with a lock-nut so as to avoid any danger of the binding-washer working loose. In instruments having binding-posts of the other type, considerable improvement can

*Extracts from a paper read before the International Association of Municipal Electricians, Pittsburgh, Pa. September 26, 1900.

be introduced by putting small hexagonal nuts a little larger than the driving heads of the binding screws on the latter, and setting them down firmly on the top of the post to act as lock-nuts.

In fuses, which are an absolutely necessary part of any installation in a modern city traversed by electric light and railway conductors, an excellent opportunity for bad contacts presents itself. The practice of securing the fuse-wire under a washer or the head of a screw is very bad, as the wire is strained, is apt to be reduced in section at some point, and cold flow of the fuse may take place. To obviate these troubles it is usual to attach pieces of copper to the ends of the fuse-wire screwing these down tightly under the binding-washers. If the fuse, as is too often the case, is merely squeezed into the copper end, the trouble is only transferred to another point. Hence, the best solution of the fuse difficulty is to use copper lugs, to which the fusible wire is securely soldered, held down by screws provided with lock-nuts. Care should be taken in installing fuses not to set them in place under strain, as their expansion and contraction under temperature changes produce crystallization of the metal or reduction of its cross-section at some point.

While the two classes of contacts already referred to are, in a large measure, in the hands of the operating force of a fire-alarm, telegraph or telephone installation, the third class, and the most important of all to us—the working contacts of instruments—are confined to these structures and their nature is determined by the manufacturer. In keys, relays, vibrating gongs, the switching apparatus of the telephone station, and in all other places where signaling circuits must be made and broken, sparks will be formed, and no practical device known to the art can prevent their formation. While dust, always inimical to good contacts, can be excluded from such places by proper construction of the instrument, nothing will prevent the formation of oxides at the point of sparking, which is also the point of contact, except making these points of some material that will not oxidize.

For this purpose, the only substances known that are at the same time good conductors of electricity and possess the necessary qualities of mechanical strength, are platinum and a few other of the rarer metals such as iridium and gold. The consensus of opinion and experience has shown platinum or certain of its alloys to be the only substance commercially available for the construction of contact points of this character. Unfortunately, platinum is a material of such great value that the expense of such contacts is greater than that of any other kind and, therefore, the temptation of the manufacturer to replace such contacts with those of cheaper material, or to stint the size, has been very great and too often has he fallen before it. He has introduced contact points of the baser metals in his instruments and this has far too often invited, if not assured, disaster.

Blame for such substitution of cheap contacts can not rest entirely upon the manufacturer so long as the users of electric signaling apparatus fail to recognize the value of the higher priced article or, recognizing it, fail to specify its use when awarding contracts, and to see that this vitally important detail has been honestly and intelligently executed in the completed instruments.

In municipal work, more than in any other, the electrical equipment must be absolutely reliable. A bad contact, sticking together or full of oxides, may mean loss and danger of the gravest sort to the community. Through failure of the fire apparatus to respond to an alarm, or of the ambulance to answer its call, or of the police to appear promptly when summoned, a bad contact may exact a fearful toll in conflagration, or death, or riot. And, in the saving of a few cents' worth of platinum, the vast expenditures of municipalities for fire and police protection, and of the generous public for hospitals, may be nullified. There is no room for economy of this wasteful kind in instruments upon which so much depends and to which, owing to the careful and conscientious superintendence of the members of this association, the public looks with perfect confidence for perfect results.

Electric Traction for Canals.

United States Consul-General Richard Guenther writes from Frankfort, Germany, as follows:

Some interesting experiments in boat traction by means of electric locomotives were recently made on behalf of the Prussian Government by Messrs. Siemens & Halske, of Berlin. The scene of operations was a short length of the Finow Canal, which forms a portion of the waterway between Berlin and Stettin and is traversed every year by about 25,000 to 26,000 boats each way. The craft used are in the main barges, some 132 feet long by 15 feet 6 inches beam, carrying 150 to 175 tons. There are also a few steam barges employed, which carry about 150 tons and can tow a second barge. The traffic to Berlin is much heavier than toward Stettin, and as a consequence three-fourths of the barges return light from the metropolis. Traction is generally effected by horses, there being a towpath on each bank, but on the down journey man traction is not infrequently relied on. In any case the speed is low, and, including stops, does not average more than about one and one-quarter miles per hour.

The section of canal used for the experiments was selected owing to its physical difficulties, presenting as it does several curves, in one of which with only 328 feet radius the waterway is spanned by a railway bridge. The line laid down for the towing engine was of one metre (3.28 feet) gauge, the outer rail weighing 18.2 pounds per yard, while the inner which was fixed on the inner edge of the towpath, weighed 9.1 pounds per yard. These rails, which were of the flange type, were laid partly on sleepers ballasted with gravel and partly on blocks of concrete, weighing 220 pounds each in the case of the heavier principal rail, and half this in case of the other rail. This arrangement costs more per mile than the sleepers, but has been found less expensive to maintain. Though no wharf actually existed on the length of canal experimented on, the arrangements necessary were fully tested. At one point, the line was raised to a height of nine feet six inches above the level of the towpath, being carried on posts and brackets. The carrying posts were 12 inches in diameter, and were spaced at 18 feet 8 inches. A cap piece spanned the gap between posts and the principal rail was laid directly on this cap piece, while the other was carried by a stringer, supported at each post on brackets.

The conductor for the current was supported on pine posts 23 feet long, located 35 to 44 yards apart. It consisted of eight-millimetre wire, carried by porcelain insulators. The principal rail served as conductor for the return current. The source of power was a 15-horse-power portable engine, driving a nine-kilowatt dynamo; and a large storage battery was also provided. The extreme dimensions of the towing locomotive were 6 feet 10 inches in length by 4 feet 10 inches wide. Its total weight was two tons; but the motor was so placed that only one-fifth of this total came on the accessory rail. The motor provided was much more powerful than necessary for the work in hand, as it was capable of working at the rate of 14 to 15 horse-power. Since, however, these experiments were merely preliminary ones intended to test the possibilities of electric traction for large barges, the excess power was supplied intentionally, and the resistance requisite to call forth the full powers of the motors was in some of the experiments provided by rafts. These experiments showed the system to be capable of meeting all needs, working, as it did, with safety and economy.

Science Brevities

Condensers—M. P. Boucherot, of Paris, on the occasion of the International Electrical Congress in Paris, recently, presented a report on the application of condensers, which in his opinion, would be used much more largely if careless construction had not damaged their reputation. Even in large installations condensers should not introduce any element of danger. Most problems concerning condensers on alternating circuits can be treated like electrical resonance questions. The author added a note on some interesting, though finally useless, novel experiments. It occurred to him that thermo-couples ought to be able to replace capacity and to bring about phase difference. He tried a hundred copper-iron disks without appreciable result, and when about to increase the number of couples to thousands, he convinced himself by a deduction, which he reproduced in the meeting, that the expected phase difference would not amount to $\frac{\pi}{2}$, as he had thought, but only to $\frac{\pi}{4}$.

M. Lombardi recommended replacing the paraffine in condensers partly by ceresine, and suggested other safety measures. A faulty connection between two distributing systems of unequal capacity could certainly produce very considerable excesses in the tension. To guard against such, we should test condensers to three times their maximum tension. The firm of V. Tedeschi & Company, in Turin, now made such ceresine condensers, of which one, capacity one microfarad for 5,000 volts, was in the exhibition. The energy dissipation by heat was low, only one per cent, as resulted from tests up to 9,000 volts, and the prices of these condensers are very moderate. M. Leblanc also thought that we should increase the capacity of our condensers. In the Champs Elysées, apparatus tested at 4,000 volts had fired at 1,500; the distribution was by means of concentric cables, and the fault rested with the harmonics which the condensers strengthened; perforating the iron sheets avoided these harmonics.

The Electrolytic Production of Gases—In an article contributed to the *Zeitschrift für Elektrotechnische,* Herr M. U. Schoop considers the commercial production of oxygen and hydrogen by electrolysis, with special reference to the use of oxyhydrogen gas for soldering purposes. What appears to be a very efficient water electrolyzer, of German design and manufacture, is described in the course of the article. In his concluding remarks, the author compares the well-known disadvantages attending the production of hydrogen by chemical means with the advantages claimed for the electrolytical generation of the same. These latter, apart from the relative cheapness of the process, consist in that hydrogen produced by electrolysis, owing to its ideal purity, enables a flame of far more intense heat to be obtained, whereby quicker work and better soldering are rendered possible, while at the same time the gas gives off absolutely no fumes calculated to injure the health, says a British contemporary. It is further pointed out that with the exception of replenishing the electrolyzers with water once in every 14 days, the apparatus requires no attention whatever. Having regard to these distinct advantages, Herr Schoop thinks there should be little difficulty in deciding to which process to give the preference.

Evaporation from Electrified Liquids—The question as to whether evaporation from the surface of an electrified liquid produces a loss of electricity is one of considerable interest in connection with theories of atmospheric electricity. An investigation of this point is given by Signori A. Pochettino and A. Sella, in the *Atti dei Lincei.* The method employed was to examine the rate at which an electrified plate lost its charge under the varying conditions when its surface was dry or was covered with a layer of water, and when it was exposed to a current of dry air or air saturated with watery vapor. The results tabulated show that the loss is more rapid in dry air than in saturated air, that with saturated air the presence or absence of the layer of water makes no practical difference, but that with dry air the discharge is actually slightly less rapid when the plate is wet than when it is dry. It is inferred that evaporation does not produce loss of charge, that the difference between dry air and saturated air is due to the fact that the dry air was ionized, while all trace of ionization had been removed from the saturated air, and that the greater insulation obtained with dry air by wetting the plate was due to the ionization being partially removed by the evaporation from the plate.

Cost of Power Generation—A paper by Mr. J. B. C. Kershaw, on "Power Generation: Comparative Cost by the Steam Engine, Water Turbine and Gas Engine," was read at the York (England) meeting of the British Association for the Advancement of Science. This was a large subject to deal with within the confines of a single paper, in the course of which the author gave some useful figures. After pointing out that the supremacy of the steam engine is now being assailed by the water turbine and the gas engine, he proceeded to refer to the development of hydraulic power during the last 10 years, on the continent and in America at Niagara. The aggregate amount of power at the present date generated from falling water forms no inconsiderable portion of the total power utilized in manufacturing industries; and two years ago it was estimated by the author to be between 236,000 and 350,000 horse-power. On the other hand, gas engineers have been busily engaged in working out the problems presented by large gas engines, and by the utilization of the waste gases of blast furnaces. Gas engines up to 650 horse-power have been built, and have worked smoothly and economically; while at Seraing, in Belgium, and at other places, the blast-furnace gases have been utilized for driving the engines which supply the blast. The aim of the writer of the paper was to collect some of the more important figures bearing on the cost of power generation.

Improvements in the Color of the Arc—Many attempts have been made to improve the violet-blue color of the arc light, which is objected to as much as ever, and, if possible, at the same time to increase the light capacity of the lamp. According to a paper read by W. Wedding before the Union of German Electricians, held this year at Kiel, a considerable amount of success has after all been achieved by H. Bremer, of Neheim, on the Ruhr River, says *Engineering.* The carbons, that is, only the upper electrodes, are impregnated with salts of calcium, silicon and magnesia up to 50 per cent of such salts being added to the carbon. Calcium appears to be the chief ingredient. The reddish yellow flame of calcium softens the tone of the light, which the inventor claims can be varied at will. The calcium oxide coats the inside of the globe, and of the chimney which is used in some lamps, with a white deposit, which helps to diffuse the light in all directions; so that we do not see a glaring point, with unsteady, ugly shadow lines on the upper half of the globe and a zone of comparative darkness directly under the lamp, but a pretty uniformly bright globe. The photometer tests, which formed the chief part of Wedding's paper, illustrate these and other features. With an arc lamp taking 12.3

amperes at 44.5 volts, Wedding observed that the light intensity was almost constant; over 6,000 candles, in the cone between 45 degrees and 90 degrees with the horizontal, and that on the horizontal itself, the intensity was still 1,000 candles. The hemispherical intensity was 4,320 candles, which corresponds to a mean current consumption of 0.126 watt per candle. This is a very remarkably low value. The lamp was without a globe; with a globe the current consumption was 0.196 watt. The carbons are vertically arranged, not quite in alignment. The mechanism is said to be much simplified, but no real information was offered on this point, beyond stating the fact that the arc is considerably flattened out and contributes materially to the light emission. The yellow nature of the light should assist these lamps in penetrating through mists. Some preliminary experiments support this view, but the subject requires further investigation. As regards searchlights and lighthouse lamps, where this penetrating power would be of paramount importance, the large arc may prove awkward; for these lamps we want a fairly punctiform source of light. A Bremer arc lamp with four arcs has been suspended at a height of 95 metres (312 feet) from the Eiffel Tower, in the Paris Exhibition. The four arcs are arranged in two series, and take together 55.8 amperes at 89.3 volts. Tested without a globe, when suspended 8 metres (26 feet) above the ground, light intensities of 80,000 candles resulted, the mean current consumption being 0.1 watt per candle, based upon a hemispherical intensity of 49,730 candles; the maximum light intensity was observed under an angle with the horizontal of 37 degrees. Fitted with a globe, the hemispherical intensity was 26,890 candles, corresponding to a current consumption of 0.17 watt. The metallic vapors in the arc diminished the resistance of the arc, but the carbons burn away twice as rapidly as ordinary carbons. If, however, the ratio of the carbon section, new to old, is 1.3, as is asserted, that disadvantage would balance itself. No vapors are supposed to escape from the globe. Bremer uses his carbons also with alternating-current arc lamps.

The town council of Wapakoneta, Ohio, has granted a franchise for an electric road through the corporation limits. The road extends from Lima to Minster, through the villages of Cridersville, St. Marys and New Bremen. L. M. Coe, F. D. Carpenter and Jacob Mayer, Cleveland capitalists, are the promoters of the scheme. They are also largely interested in the interurbans entering Toledo and Cleveland. The company has plenty of money and the road will be pushed to a speedy conclusion.

Demand for Telegraphic Appliances in Turkey.

United States Vice-Consul General Albert sends from Constantinople, September 5, 1900, a letter from Consul Norton, of Harput, in reference to the bids for supplies to be presented next month to the director of the Turkish postal and telegraphic service. The material is required in the construction of a new telegraph line.

One of the leading firms of Constantinople, says Mr. Norton, is desirous of securing quotations from a first-class American house to use in this competition. The telegraphic supplies which it has hitherto furnished the Ottoman authorities have been of English and German manufacture. The firm feels that the time is ripe for American material of the character in question to enter the Turkish market, with a fair prospect of success. Quotations should be received by October 10, though a delay of a week or two will perhaps not prevent consideration, as the date for final reception of bids is frequently postponed a fortnight or more. The house requesting these figures is reliable, and there will be no delay in payment. The articles required are:

Galvanized iron wire of five millimetres (0.177 inch), kilogrammes, 532,800.
Galvanized iron wire of four millimetres (0.156 inch), kilogrammes, 133,500.
Large insulators, with iron accessories, pieces, 40,725.
Small insulators, with iron accessories, pieces, 20,000.
Large insulators, with iron accessories, pieces, 2,225.
Small insulators, with iron accessories, pieces, 7,000.
Posts, made after the Siemens pattern, number, 1,000.
Posts, made after the Siemens pattern, number, 200
Drawings and full descriptions (in French) of these articles are filed for reference in the Bureau of Foreign Commerce, where they can be examined by interested parties.

Offers are to be sent to M. Edouard Zanni, Haratch Han, Stamboul, Constantinople (open mail, *via* London). Correspondence may be in English, but should be preferably in French. Prices should be expressed in francs (19.3 cents), and should be c. i. f. Constantinople, *i.e.*, packing, freight, insurance and all charges (except customs dues) paid to Constantinople. Payment will be made by draft on London or Paris, immediately on receipt of goods. Quotations should be received at Constantinople by October 10, or as soon thereafter as possible. In case of acceptance a formal contract will be made at the United States consulate-general. The material will be furnished in several lots. Three months' notification will be given of the time for receiving each separate lot.

The United States Telephone Company has been having considerable trouble in building its lines through the town of Granville, O. It seems some of the linemen have used their axes a little too freely on some of the trees in front of private residences and a great cry went up from the property owners. One day last week Mayor Lewis swore in a number of deputies, who chopped down some of the telephone poles, and he ordered them to shoot if the company persisted in cutting the trees. Later, an amicable agreement was reached between the city council and representatives of the company by which the latter were permitted to string their wires.

FIG. 1.—ILLUMINATION OF THE FERRY BUILDING, SAN FRANCISCO, AND FIREWORKS.

ELECTRICAL ILLUMINATIONS FOR CALIFORNIA'S SEMI-CENTENNIAL.

BY O. H. PACKER.

There was recently held in San Francisco a three days' celebration of the semi-centennial of California's admission into the Union. The decoration of the city

FIG. 3.—ELECTRIC ILLUMINATION OF THE CITY HALL, SAN FRANCISCO.

was in progress two weeks before the celebration and, as prizes were offered for the best decorations, store fronts and buildings were most elaborately dressed for the occasion. Festoons of green were hung gracefully along the streets, supported by posts set on either side of the highways for many miles. These posts were each capped by a stand of flags and covered with green foliage. Over the streets hung almost a canopy of electric lights and many buildings were elaborately decorated.

Referring to the illustrations, which are from negatives made by the writer, Fig. 1 shows the Ferry Building and the fireworks. Fig. 2 is a view of part of Market street, looking toward the tower of the Ferry Building, which is seen in the distance, and showing the general style of electric light decorations employed and the building of the San Francisco *Chronicle* in the immediate foreground. The streak of light in the streets is due to the passage of street cars and bicycles. Fig. 3 shows the elaborate and beautiful decoration of the City Hall.

Perhaps no other city in the United States has the facilities at hand for such an electric display. Over 6,150 lights were employed in street illumination alone. The lights were suspended in festoons along both sides of Market street for a distance of 9,000 feet, with a festoon of red, white and blue lights suspended across the street every 300 feet, except in the Court of Honor at the junction of Kearney, Geary, Market and Third streets, where 1,150 lights were placed in the form of suspended stars. There was also a large star of lights placed horizontally at a height of 120 feet above the centre of the Court of Honor, and two streamers of lights were run from this star to the festoons of lights below. The star alone weighed 450 pounds.

On Kearney street 1,000 lights were placed; on Montgomery street, 500 lights; on the Ferry Building, 1,700 lights, and on the City Hall dome, no less than 3,700 lights. For the decoration of private buildings about 3,500 lights were employed altogether. There was a total of 16,450 lights used in the various street illuminations. The street lights were installed by the Wybro-Hendy Company, and the current for all the lighting except that of the Court of Honor was supplied by the San Francisco Gas and Electric Company. The Court of Honor was illuminated by current donated by the Mutual Electric Light Company.

The current supplied was by means of three wires extending the entire lengths of the street and feeding into the festoons every 300 feet, thus maintaining uniform pressure and even distribution of light throughout. The method of lighting up was so arranged as to make the illumination appear like a wave of light sweeping from one end of the city to the other.

The celebration furnishes one further illustration of the fact that nothing lends so much beauty to a city's decorations upon festival occasion as a judicious display of electric lights. An elaborate parade of 27,500 persons, all uniformed, with 50 floats and 80 bands of music, was a feature of the festivities. The total expenses of the celebration committee were $50,000.

San Francisco is one of those cities that possesses a marked civic spirit and one needs only to look at the accompanying illustrations to see how beautifully it rose to the occasion of this decoration and what artistic use was made of electric lighting as a feature of the celebration.

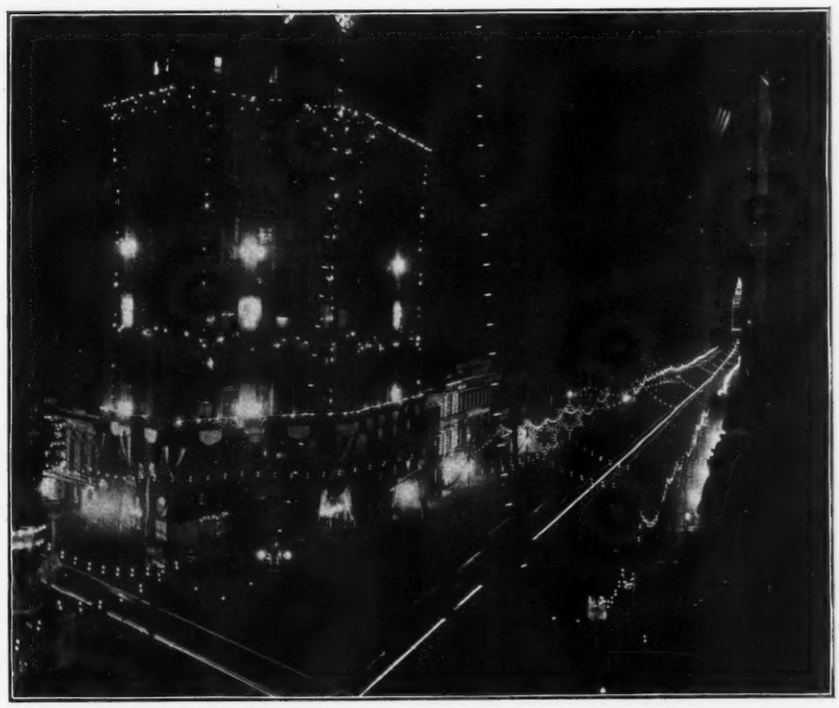


FIG. 2.—THE ELECTRICAL ILLUMINATION OF MARKET STREET, SAN FRANCISCO.

A New Electrical Engineering Firm.

The Electric Controller and Supply Company, of Cleveland, Ohio, informs the ELECTRICAL REVIEW that it has entered the field of consulting electrical engineering and will be pleased to receive catalogues, price lists and full particulars regarding wire, switches, supplies, rheostats, motors and storage batteries. The officers of the company are: Chas. H. Wellman, president; John McGeorge, vice-president; Harold McGeorge, general manager, and William W. Adams, secretary and treasurer.

The Gallipolis & Point Pleasant, Ohio, Electric Street Railway, which was owned largely by the Hocking Valley Railway, has been abandoned and the tracks torn up and equipment shipped away. The road did not pay expenses.

METHODS OF GENERATING AND TRANSFORMING ELECTRIC CURRENTS FOR THERAPEUTIC USES.*

BY CHARLES T. CHILD.

It is with no little diffidence that I approach a subject of which I am profoundly ignorant—at least in so far as your side of it is concerned. I must say at the outset that I know nothing about the therapeutic applications of electricity, and that I propose to confine myself here entirely to a statement of the methods in use for generating and transforming electric currents and electrical energy as you use it, feeling that you know thoroughly well how to apply the electricity after it is generated and put into the form that you desire.

Any manifestation of electrical energy may be completely defined by three particulars. These are the quantity flowing in the circuit under consideration, the pressure under which it flows, or which has caused it to flow, and the frequency with which it moves through a complete cycle of definite changes in its various characteristics. We may say that what is ordinarily known as a direct current is a special case of alternating current, in which the frequency is reduced to zero. To begin, therefore, with this simplest case of direct current, we need in any special instance to know only two things about a given manifestation of it. One of these is the electro-motive force or tension, which we measure in volts, under which it acts, and the other is the volume of the current flowing, which we measure in amperes or the more convenient unit of the milliampere, one-thousandth the size of the other unit.

In its applications for therapeutic purposes the electric current of this character is used at pressures varying between a few volts to about 60 or 70 volts, which seems to be the maximum limit of pressure ordinarily employed where such currents are associated with any measurable flow. There is another variety of direct or undirectional voltage employed which is measured by thousands of volts, but in this case the energy used, which is measured by the product of the pressure in volts into the current flow in amperes is less rather than greater than in the former instances.

There are two ways in general use for producing direct-current voltages for medical application. One of these is from the familiar battery and the other is the transformation process whereby the higher pressure current of electric light supply systems is cut down by suitable apparatus to the desired tension. The electric battery has just enjoyed the centennial of its birth. Invented by Volta in 1800 it has been brought to a degree of perfection that compares but poorly with that of other electrical apparatus of more recent origin. The battery, to-day, is still the same wet, somewhat troublesome contrivance that it has always been, although we have what are called dry batteries. Somebody has suggested that the dry battery is so called because it is always wet inside, while the wet battery is known frequently to dry up.

For the ordinary purpose of the practitioner the dry battery is a more convenient form of this apparatus than that using open cells containing liquids. The construction of the dry battery is exceedingly simple. It generally consists of a zinc vessel, in the centre of which is placed a rod of carbon, the space between the two being filled with some absorbent material, such as moss or excelsior or plaster of paris, saturated with the electrolyte. The cell is then sealed with pitch or some compound of similar properties and is ready for use. Notwithstanding its convenience, the dry battery, which is generally of the variety that polarizes quickly, is not valuable for purposes requiring a considerable flow of current for some length of time. If it is attempted to withdraw from any such battery a large current, it quickly becomes inoperative on account of the formation of hydrogen upon its positive pole. Hence for the mechanical applications of electricity in the physicians and surgeons' province, such as the operation of motors and cauteries and the like, if battery currents are used, recourse must be had to other varieties which do not suffer from this detriment. For this purpose certainly the best type is the storage battery, although large use is made of cells containing a depolarizing agent such as bichromate of potash. It is needless, however, to dwell here longer upon the subject of the primary battery. Dry cells are so good and so inexpensive that they last a long time in use, and may be repaired when worn out at comparatively small cost.

For transforming from the higher voltage of the direct-current electric lighting mains to the pressures used in therapeutic work, the simplest method is that employing a shunt around a resistance. Resistance may be of almost any form, but it is most conveniently made of coils of wires or else of incandescent lamps. In order to avoid abrupt steps in the gradation from lower to higher voltages in this apparatus it is necessary that the resistance coil used should be very finely subdivided, or else so arranged that contact may be made with it at any point of its length. This is generally secured by winding resistance wire on a drum, so arranged that a brush or sliding contact may touch any spire of the coil. In this way extremely minute subdivision is attained and the voltage applied to the patient may be varied with the utmost delicacy to suit the requirements of the case. Other varieties of shunt resistances have been much employed, notably water or liquid rheostats, which have given very satisfactory results. It is a practice, also, to use series resistances between the terminals of the shunt and the electrodes applied to the patient, but it does not seem possible to attain with this arrangement the same continuous and accurately known electrical pressure at the electrodes.

Passing now to direct-current voltage of great intensity, we find that this is almost universally generated by the static induction machine. It would take us too far afield to go fully into the extremely beautiful theory of the operation of such machines, but it may be said in passing that they depend upon the principle of the familiar electrophorus, which is in them made continuous in its operation and cumulative in its action. They generate potentials up to several hundred thousand volts, but as the internal resistance of the machine is practically infinite its discharge does not partake of the continuous character of that given by a battery, but is due to the equalization of pressures upon surfaces relatively small in area in various parts of the mechanism. Resistance of the static machine, however, has really nothing to do with its applications to your purposes. It may be regarded simply as a means of generating and maintaining very high electrical pressures, and these are utilized practically in three different ways. Actual sparks are sometimes applied to the patient, and the complexity of this phenomenon in view of its apparent simplicity is astonishing. The electric spark is due to the break-down of the air between two points of sufficiently great difference of electrical pressure. Of the precise mechanical nature of the rupture we have no very clear conception, but for our purposes it is sufficient to know that a good static machine will keep up a continuous torrent of sparks between its terminals so long as the crank is turned. If, however, the terminals are separated to a distance greater than that over which the spark will leap, there occurs a curious phenomenon known as a brush discharge.

*Read before the American Electro-Therapeutic Association, New York, September 26, 1900.

This is visible in a darkened room as a glow of light issuing from the poles. It is, however, similar in its effects to continuous currents, although there is little doubt that it is more nearly allied to the variety of current flow found in electrolytes than that familiar in metallic conductors. A third application of the energy derived from the static machine is that which I believe is called in your practice the "static induced current." To produce it two condensers or Leyden jars are attached to the terminals of the machine, and from their other coatings or surfaces conductors are led to the patient. When a spark strikes between the terminals of the machine the phenomenon known as oscillation takes place, and these oscillations, of astounding frequency, running into the hundreds of thousands per second, permeate whatever is attached to the machine. This is a genuine case of transformation, since the increasing direct potential accumulating in the Leyden jars is suddenly relieved by the passage of the spark, much as if a spring is bent and suddenly let go, and the whole system is thrown into exceedingly rapid vibration, dying out after a brief period but in the interval acting as an alternating current of high frequency.

The alternating current finds much use in electro-therapeutics. It may be defined by that variety of electric current that changes its direction and intensity of flow through regular and periodical cycles. It is produced in a large number of ways, but for the purpose of the therapeutist practically only by induction coils, alternating current or sine wave generators, and the apparatus commonly called high-frequency coils. The induction coil and the principle upon which it operates are doubtless familiar to all of you. When the primary of the apparatus is connected with a source of electric current the current in the coil does not instantly attain its full strength, but gradually builds up; whereas, when the current is broken in the primary coil it ceases to flow with great suddenness. The effect of this action is to cause the induced or secondary current to be much more intense in one direction of its flow than in the other, or, to put it in other words, the wave-form of the secondary current shows sharp peaks and points on one side as contrasted with a more rounded course on the other. If any suitable resistance, such as an air gap, is connected with the secondary terminals the effect will be that only currents due to the sharp pointed waves of electro-motive force in one direction will pass. To sharpen the break of the primary current has been the effort of a generation of experimenters and the subject of interrupters is so voluminous and complex that one rather hesitates to approach it. There are several groups of designs for these apparatus, ranging from the familiar hammer break of the older coils, through the various rotary types, to the beautifully simple and efficient liquid interrupters of recent introduction. The whole instrument, coil and interrupter, forms a piece of apparatus embodying two kinds of current transformation. One of these is the transformation of the direct current into the alternating current by the interrupter, and the other is the further transformation of this alternating current into one of higher intensity and less volume by the electro-magnetic induction of the coil itself. The broken, discontinuous, but none the less truly alternating, current of the primary circuit is frequently used in therapeutic work. There are also numerous applications of the secondary current whose sharp pointed wave form makes, whenever it encounters high resistance, practically a succession of direct current pulses. In order to attain a variety of effects dependent upon the energy of this secondary discharge recourse has been had to multiplicity of windings in the secondary coil. This, however, seems to be unnecessary in view of the large modification in both the energy and the wave-form of the secondary discharge that may be made by using suitable interrupters and condensers in connection with the primary circuit.

Very similar in its method of operation, although widely different in design and appearance from the induction coil, is the high-frequency coil. This is an induction coil or step-up transformer operated, however, by exceedingly rapid alternating currents from the oscillating discharge of a condenser. On account of the enormous frequencies and high voltages produced, the behavior of high-frequency discharges is widely different from that of the longer known forms of electrical current with which we are all familiar. It seems likely that this variety of electrical manifestation will have abundant opportunity in your professional work to demonstrate its usefulness and it has already given, in certain hands, high promise of important results.

As a final case of current transformation may be mentioned the various modifications of the rotary converter. This machine is in all respects similar to an ordinary direct-current dynamo or motor, but its armature winding is tapped at two or more points and conductors led from these to rings on the shaft of the machine upon which rest collecting brushes. If driven as a motor from the direct-current side, alternating currents may be taken from the collector rings; conversely, if operated at an alternating-current motor, direct current may be taken from the commutator brushes. For certain of the mechanical operations of the therapeutist this machine has proven itself invaluable, insomuch as its output of alternating current is susceptible of all the great range of transformation in voltage which may be attained with ordinary induction coils or transformers in connection with that variety of current. Its use has not yet extended in a large measure to directly therapeutic operations, but there is little doubt that it has a future before it in this direction.

In this attempt to sketch briefly the principal methods of generating and transforming electric currents for your uses no reference has been made to the applications you make of the various types of currents, nor to the results that have already been attained in this most recent branch both of medicine and electricity. It is impossible to contemplate the electrolytic actions of the current, its effect upon osmosis, its action upon nervous tissues or the extraordinary phenomenon of cataphoresis without being vividly impressed by the possibility for good inherent in the judicious exercise of electricity as a curative agent. It is equally evident that where great good can be done by wise and systematic utilization of electricity equally great harm may result from the injudicious, ignorant and often improper use of this powerful agency. For this reason the dissemination of accurate knowledge as to the therapeutic action of electricity is of vital importance, and it is pleasant to witness an association such as yours engaged in giving publicity to the accumulated knowledge you have acquired in your individual experiences.

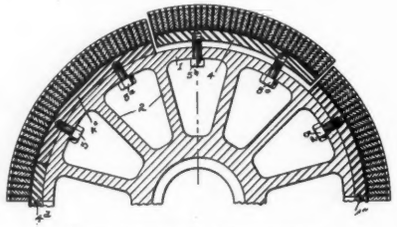
A New Accumulator Plate.

A new secondary battery-plate on which a patent has recently been obtained, consists of a central metallic conducting plate, to the opposite faces of which are secured sheets of natural vegetable fibre which is impregnated with lead oxide in the form of a paste. These sheets are secured in any manner to the conducting plate and the whole is then subjected to a long and continuous charging of electricity which forms the paste and fibre into a solid mass, after which the plates are in a condition to store electricity. The inventor, who is Mr. William Bowker, of Waltham, Mass., claims that this makes a practical plate, and has the advantage of being exceedingly light and inexpensive to manufacture.

Recent Electrical Patents

In order to obviate the necessity of soldering the joints of conducting wires, Mr. Willard F. Barber, of Wilkesbarre, Pa., has invented and patented a metallic cement which may be applied to the joint by hand after the wires are twisted or otherwise mechanically secured together without the use of heat, and for all practical purposes takes the place of solder. The cement consists of an amalgam, with which is mixed a suitable binding material, the mass thus formed having about the consistency of putty. When put in stick form or in mass, the cement will not harden, except at the surface where a slight crust is formed, and when the mass is worked between the fingers it becomes soft and plastic, so that it may readily be applied to the wires. In making a joint the wires are first twisted or otherwise mechanically secured together, and the joint thus formed is then coated with the cement, the latter being applied with the fingers. The cement consists of the following ingredients in the proportions specified, the parts being given by weight: zinc, four parts; tin, two parts; copper, two parts; cadmium, two parts; bismuth, four parts; lead, two parts; antimony, one part, and mercury, eight parts. The solid metals are granulated and melted together, after which the mercury is added, the mass being stirred at the same time. When cool, the mass is pulverized in a mortar, and a binding material, consisting of liquid glucose and silicate of soda, in sufficient quantity to bind the mass together and give it the consistency of putty, is added to the mass and thoroughly incorporated therewith. The binding material preferably consists of equal parts of the ingredients mentioned. The cement thus forms, as previously stated, will not harden when in bulk, and may easily be worked between the fingers; but when spread out upon a joint, it not only adheres to the latter but hardens in from 12 to 24 hours. The cement may be applied to the wires without any previous application of acid, and by amalgamating with the conductors it forms as perfect an electrical union as could be formed by the application of solder without the inconvenience attending the application of the latter. The application of the cement prevents oxidation of the wires. After the joints are thus made they are covered with an insulating tape in the usual manner.

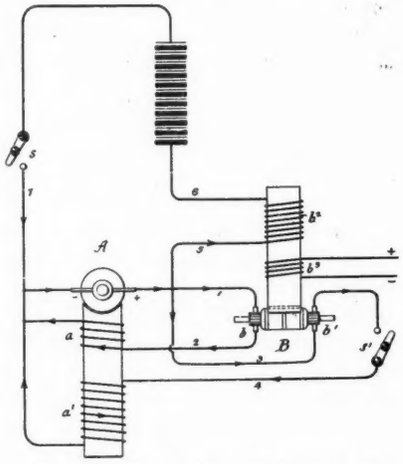
A patent on a commutator has been granted to the General Electric Company, of New York, N. Y., as assignor, which has for its object to provide a commutator for an electric machine that will be free from distortion under centrifugal or other strains, thus tending to keep the several bars of the commutator in perfect alignment during the entire period of service of the machine. It is accomplished by locking the several bars of the



DISTORTIONLESS COMMUTATOR.

commutator together, so that no one of them can slip with relation to the others, by means of a key passing through the several bars, but insulated therefrom. The key is formed sectional, each segment supporting and locking a number of contiguous commutator segments. A keyway is preferably provided at or near the middle of the length of the bar, so as to bind the latter down against the supporting drum for the commutator bars. In assembling the commutator, the keys, with their segments, are set successively in place and fastened by bolts on the inside of the cylindrical support. The keys are carefully insulated from the commutator segments by a lining of mica or other satisfactory material on the inner walls of the keyway. The last segment inserted after the balance of the commutator has been assembled, may be insulated by strips of mica or similar material fastened over the end walls of the key segment, and its commutator segments and the combined parts slipped into place and bolted fast, after the fashion of the balance of the segments.

In electric lighting plants for railway cars driven from the axles, because of the wide variation of speed, it has been extremely difficult to maintain a constant pressure on the circuit. A recent invention by Mr. Imle E. Storey, of Trenton, N. J., in this line, however, seems to solve this difficulty in a very satisfactory manner and provides a sensitive and quick-acting mechanism which will maintain a substantially constant voltage no matter at what rate of speed the car may be running. Broadly, the invention consists in providing the generator with two coils or sets of coils on its field magnet, one of which is the regular exciting coil, while the other is an opposing coil, the function of which is to neutralize the effect of the exciting coil. In conjunction with such a generator used there is an electric machine driven as a motor by current from the dynamo and whose armature carries coils independent of the motor-coils, in which a current is generated and separately commutated. The exciting coil on the field magnet of the generator is in a shunt to the brushes of the generator, which also includes the motor armature, while the opposing coil on the field magnet of the generator is in a similar but separate shunt, which includes those coils on the motor armature in which current is generated, such generated current augmenting that which, ordinarily, is shunted from the brushes of the main generator and which is sent through the opposing coil in the proper direction to create an opposing magnetism in the field. The field magnet of the motor is in the main circuit of the generator. The different circuits are provided with switches. The main generator is started with both switches open. When the voltage of the main generator rises sufficiently to charge the battery or supply other translating devices in the

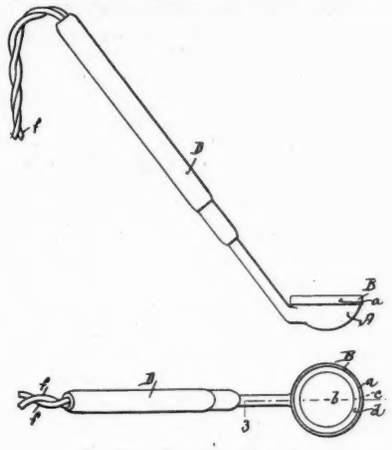


VARIABLE SPEED DYNAMO REGULATOR.

main circuit, both switches are closed, whereupon the strong field, which is immediately built up in the auxiliary machine due to the excitation of its field magnet coil, generates current in those coils of the armature connected with one commutator, which current flows in the opposing coil and augments the current in that coil flowing from the main generator. Since this current in one coil opposes that flowing in the other, the electro-motive force of the main generator will be lowered in proportion to the electro-motive force of the main circuit, which includes the field magnet of the auxiliary machine. Any increase of speed of the main machine will increase the lines of force in the machine which are cut by the coils connected to the commutator, so that there

will necessarily be an automatic regulation of the voltage of the main machine.

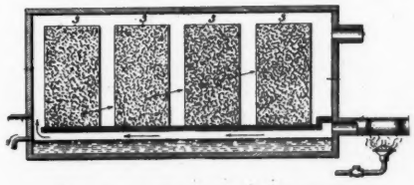
While electric lamps have often been employed in medicine and surgery, it is believed that the electric lamp for dental purposes devised by Mr. Bryon E. Lawton, of Providence, R. I., is a decided novelty and a very useful instrument. The device is a combination mouth mirror and illumi-



DENTAL ELECTRIC LAMP.

nator, and consists of the usual handle, to the end of which is secured the mirror. This mirror is arranged at an angle to the handle, and forms a cover for a bowl within which is housed a small incandescent bulb, the wires of which pass up through the handle. The mirror is made with a rim of clear glass, the central portion only, being provided with quicksilver, and thus when placed in the mouth, the light will shine through this rim and reveal the condition of the teeth which will be reflected within the mirror.

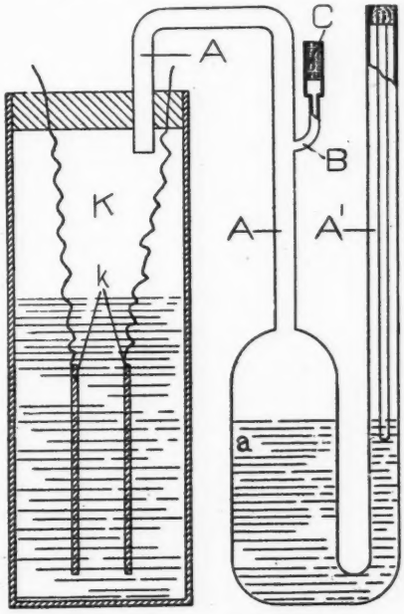
An improvement in the manufacture of negative electrodes for primary batteries has recently been patented by Mr. Clyde J. Colman, of Chicago, and relates more particularly to that type which are composed mainly of copper oxide. The object of the improvement is to provide a simple and efficient process of oxidizing such copper oxide electrodes and in which



OXIDIZING NEGATIVE ELECTRODES.

a very perfect agglomeration of the oxide upon the holding support or casing is effected coincident with the process of oxidation to produce a negative electrode that is free from the usual cracks or seams and the consequent inert portions, bad contacts and high resistances. Accordingly, the process comprises the filling or coating of the casing or support with finely-divided or porous metallic copper in any usual and approved manner and the conversion of such filling or coating of metallic copper into an active oxide of copper by a continued exposure until such filling or coating is wholly converted into an oxide. In like manner the process involves the reoxidation of negative battery electrodes in which the active copper oxide has been reduced to metallic copper by previous use in a battery. In carrying out this process he provides a closed chamber, the bottom of which is arranged a supply of water. The electrodes to be treated are supported above the water and are subjected to a current of heated air which is first passed over the water.

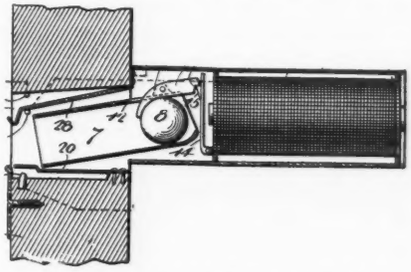
One of the most ingenious devices for indicating the maximum electric current passing through a wire, is the invention of an Englishman, Mr. Ernest C. Rimington,



MAXIMUM CURRENT INDICATOR.

a resident of London. He proposes to employ the volume of gas liberated in a given time by the electrolysis of a passing current to operate a suitable indicator that is properly adjusted to record the amount of current passing. There are several ways of accomplishing this, but the following construction has proved to be very satisfactory. This consists of a closed electrolytic cell having the usual electrodes. A U-tube is connected with this cell, so that all the gas generated must necessarily pass into the same. The lower portion or bend of the tube is filled with a suitable liquid, and the upper free end is closed by a porous cap which allows the confined air to gradually escape as the liquid is forced up by the pressure of gas. Several kinds of indicators may be used; for instance, a rod may be inserted longitudinally in the free end of the tube, and the liquid may be of such a composition that it will stain this rod, or the rod may be provided with a dissolvable color that will be washed off as the liquid ascends. Arranged in the other leg of the tube is a suitable valve which permits the gas to escape under normal conditions or, while the generation is stopped, thus allowing the liquid in the U-tube to return to its level.

One of the latest additions to the art of telephony is a combined telephone signal and jack, the invention of Mr. Oren R. Cline, of El Dorado, Kansas. In the usual jack-socket opening is arranged a



COMBINED TELEPHONE SIGNAL AND JACK.

tube which is tiltably supported and inclined downwardly. Within this tube is arranged an indicator, which is preferably in the form of a ball that can roll freely therein, and is normally held in the upper or back portion of the tube by means of a trip that is adapted to be operated by a suitable electromagnet. At the forward or outer end of the tube is arranged a spring plate that forms a circuit closer for the alarm. In operating the device, when the electromagnet is energized by a "call" the dog is tilted and the ball rolls down to the front end of the tube, at the same time it closes the alarm circuit, ringing the bell and thereby notifying the attendant of the call. The usual plug is then inserted in the opening, and is arranged to push back the ball to its original position ready to be operated. Thus no act is required to return the signal other than the mere insertion of the plug, the ball being positively returned and being retained in a manner that will absolutely prevent accidental dislodgement and consequently a false signal.

The grading on the Sandusky, Bellevue, Monroeville & Norwalk, Ohio, Electric Road is all done and the sale of $600,000 worth of bonds to a Philadelphia concern recently, guarantees the early completion of the road.

RAILWAY POWER TRANSMISSION.*

BY A. H. ARMSTRONG.

In adopting 500 volts for railway service in the earlier days of the industry, it was thought that a sufficiently high potential had been chosen to make line losses a secondary consideration. The weight of cars and size of motors first used made it necessary to use much feeder copper in addition to the trolley wire, which, in most cases, had sufficient carrying capacity to have the cars at the extreme end of the road. The public were not very exacting in their requirements for rapid transit and were satisfied with a service that would not be tolerated in our smallest systems of to-day.

The heavy cars, high schedule speeds and frequent stops of modern electric railroad service have increased the car energy consumption to such an extent as to make the question of supplying a reasonably constant voltage over a large network one of the most important questions to be dealt with. Not only is this true of long-distant suburban roads, extending 30 and 40 miles from the power house, but the large city systems have been so increased in extent by the consolidation of many small roads as to render almost inoperative the old system of 500-volt direct-current transmission from a single feeding point. The city system differs from its suburban offspring only in the more steady character of the station load, as the number of miles of track operated from a single generating station and the length of the longest feed in some of our large city systems is equal to or greater than any of our suburban roads now in operation.

The economical distribution of energy to the various units operating in a large railway system is therefore a question of as great importance and one to be treated along approximately the same lines in city service as in long-distance cross country roads. This is especially true when we consider the advantages of locating a generating station in the outskirts of a large city, where coal and water are available, facilities for removing ashes at hand and real estate cheap, contrasted with the operation of one or more generating stations around which a growing city has spread itself, bringing up the fixed charges and operating expenses to a prohibitive limit.

In considering so large a question as the proper generation and distribution of power for railway service it will not be possible to enter into the many local details which will largely govern the system adopted in many cases, but various points common to all systems will be touched upon, and some of the limitations of the various systems of operation brought out.

There are five recognized methods of distributing power which are applicable for railway work:

1. Five-hundred-volt direct-current distribution, using the standard 500 to 600-volt direct-current railway apparatus.

2. The operation of series-wound, direct-current boosters in connection with 500-volt direct-current apparatus.

3. The use of three-wire distribution, using the track as a neutral.

4. Alternating-current distribution, employing the use of alternating-current generators of high potential with step-down transformers and rotary converters suitably located.

5. Alternating-current generation and transmission, with alternating-current induction motors mounted upon the cars in place of the direct-current motors in the above four methods.

Excepting the last method of transmission—alternating-current generation with induction motors—practically the same conditions govern the operation of large city and suburban roads. The design and operation of alternating-current induction motors, however, depends entirely upon the character of the service which they are to perform and their use will, therefore, be considered separately.

The first three methods of operation can be considered under the general head of:

DIRECT-CURRENT DISTRIBUTION.

The advantages resulting from the concentration of generating apparatus in a single station have been demonstrated by the elimination of the various small generating stations when a number of small railway interests have been consolidated: operating expenses are reduced thereby partly on account of the reduced number of attendants required, less real estate carried on the books, and largely by the reduced coal consumption resulting from the more even load curve having small fluctuations.

In combining a number of 500-volt direct-current stations into one power house of their combined capacity, one of the most serious limitations of the direct-current system is immediately met with, that is, the limited area over which power can be transmitted economically with a reasonable amount of capital invested in feeder copper. If the generating station is located in the centre of distribution of a closely congested district, the copper investment will be comparatively small, but the price of real estate is high, and the location carries with it the probability of expensive water supply for condensing purposes and poor facilities for handling coal and ashes. The generating station also is likely to be hemmed in and little chance left for expansion, except at excessive cost of acquiring adjoining property. Hence although such a station operates at high efficiency as regards the transmission of power, including interest on capital invested in copper, there are many fixed charges and operating expenses tending to bring up the total cost of generating power.

A generating station located in the heart of a city has to contend with the continual growth in the outskirts and the increased needs of heavier and more frequent car service at what soon becomes a considerable distance from the centre of distribution. It is also probable that parks and pleasure grounds will be located in the outskirts of the city at considerable distance from the power house at which it is necessary to concentrate a large number of cars at very infrequent intervals.

The problem then becomes one of installing sufficient copper to take care of a service occurring but a few times during the year, during the remainder of which the copper investment is lying idle, or of installing series-wound boosters with a comparatively small booster feeder extending to the point of concentration of load. The booster in itself is expensive to operate as it represents a dead loss of so many watts in the booster and feeder copper, but its operation for intermittent service of this character is fully warranted and preferable to the installation of a large amount of feeder copper carrying with it large interest charges, which are not warranted by the average traffic during the year.

The further increase in the growth of the town introduces new factors in the way of suburban connections which it is desirable to operate under the same management and from the same generating station as the city lines which feed them. The distance from a generating station centrally located for the congested traffic is perhaps so great as to necessitate a capital investment in feeder copper whose interest charge off-sets the profits from operating such suburban connections. It is true that a direct-current generating station can be located somewhat outside the centre of distribution of city load and in the direction of probable suburban extensions, but this entails a transmission of the main bulk of the load some distance to the centre of distribution resulting in a cost for power which added to the interest on copper invested may offset the advantages otherwise accruing to a suburban location.

Boosters may be installed for permanent operation, but while it is true that local conditions largely govern the use of boosters, it can be generally stated that it is not economical to operate them on continuous service, while for intermittent service to help out a poorly coppered line on some special occasion, they are valuable and might well be included in the apparatus of a central station.

The three-wire system has been mentioned as a possible means of power transmission for railway work, but only a general reference can be given to such a system owing to the delicate nature of balancing the two sides of the circuit, which is almost entirely a matter for local consideration. Such a system must necessarily require more care in laying out and more careful attention during operation than straight 500-volt distribution, but it may, in certain cases, afford sufficient advantages to warrant its adoption. In heavy work on private right of way where no objection exists to the use of two third rails, a balanced three-wire system may be used in which unbalancing is overcome, but the conditions demanding the adoption of such a system, are entirely local and calls for special consideration.

*A paper read before the Street Railway Association of the State of New York, Buffalo, September 18, 1900.

Most of our large city railways and practically all of our suburban roads operate their cars upon a recognized schedule, which is being adhered to more and more as the public become accustomed to a time table on electric roads. Where the headway is very short, say two or three minutes or less, it is not necessary to refer to any time table, but most systems operate on a longer headway, and in such roads it is of the greatest importance that favorable conditions exist for the maintenance of a predetermined schedule. The 500-volt direct-current system fed from a single generating station centrally located, affords full station potential in the congested district where it is least needed, and minimum potential in the outskirts where the highest speed running is called for. If suburban connections are provided, the line voltage over an extended route will fall considerably from the bus-bar potential and a schedule that can be maintained satisfactorily during normal operation becomes inoperative with such a system of distribution during hours of maximum service, owing to the considerably increased feeder drop at such periods. As the headway of cars is not so short as to interfere with the maintenance of schedule speed in the outskirts or on suburban lines, the copper investment becomes the determining factor in the maintenance of the schedule speed in the outskirts or on suburban lines, the copper investment becomes the determining factor in the maintenance of the schedule and the overload capacity of the system. Many of our suburban roads parallel steam roads and depend for their existence upon their ability to make as good time with more frequent stops as their steam competitor. The ability of the electric cars on such roads to make high schedule speed depends upon the maintenance of a good average line voltage over the entire route, while the frequency of service being perhaps one-half hour between trains is not sufficient to warrant the very great feeder copper investment that may be demanded by 500-volt direct-current distribution from a single generating station.

The necessity of reenforcing the trolley voltage at intervals along an extended route has led to the development and adoption of the alternating-current system of distribution, which will be discussed under the general head of:

ALTERNATING-CURRENT SYSTEM OF DISTRIBUTION.

The alternating system consists in brief of a generating station containing alternators generating multiphase currents of several thousand volts, or generating currents of low voltage which are stepped up to the required line potential, and transmitting this voltage over a high-tension transmission line to sub-stations suitably located. These sub-stations contain step-down transformers and rotary converters, but may contain motor generator sets with an alternating motor wound for receiving the high-tension voltage direct, without any intermediate transforming devices.

The system therefore possesses the advantages of being able to transmit energy over large areas at high voltage with a consequent small copper investment and small loss, while it can be transformed to direct current of 500 or 600 volts wherever most needed.

Owing to the large area which it is possible to feed from a single station any local fluctuations of load are smoothed out and the generating station load curve can be made comparatively free from momentary fluctuations, thus resulting in high coal economy.

Where the length of the transmission line is comparatively small and potentials of not more than 10,000 or 12,000 volts are required for economical distribution, it is possible to wind the alternating-current generators for the line voltage, thus dispensing with step-up transformers, but these become necessary where transmission potentials of 20,000 volts or more are necessary to keep line losses small with a reasonable investment in transmission copper as it is expensive to wind generators for such high potentials. Step-down transformers must always be used in sub-stations where rotary converters are employed, as the voltage of the alternating side of the rotary converter bears a fixed ratio of about 64 per cent of the direct-current voltage, being thus approximately 350 volts for a 550-volt direct-current converter of the three-phase type. Motor generator sets may, however, receive line voltages up to 10,000 volts, but the saving of step-down transformers in this case is off-set by the extra cost of the motor generator set over the rotary converter.

The alternating system has to contend with the loss incurred by transforming high-tension alternating current to 500 volts direct current, this loss being approximately eight per cent at full load of converters and transformers. There is added to this a transmission line drop of four or five per cent, making the total drop from alternating-current generators to the direct-current bus-bars of the sub-station probably 12½ per cent at full-load. In figuring upon the adoption of alternating-current apparatus for railway work this loss of 12½ per cent must be taken into consideration and balanced against extra interest charges of copper investment and larger direct-current feeder drops of the straight direct-current system. To be more exact the cost of the energy lost in feeder copper and transforming devices should be added to the cost of the sub-station attendance and interest charges on feeder copper for the alternating system and compared directly with the power lost in feeders and track, and interest on copper investment of the straight direct-current system.

The cost of maintaining a rotary converter sub-station becomes a comparatively small factor in the operating expenses, due to the fact that a large part of this expense can be charged up to other accounts. In suburban roads the sub-station attendant combines with his other duties, that of ticket seller, train despatcher, etc., duties which would demand the service of a man if a sub-station were not located at that point. In large cities, systems where sub-stations are of considerable size, a certain amount of attendance is required, but this expense is small, as the duties of a sub-station attendant are very light.

The alternating system possesses the great advantage of being perfectly flexible and adapted for future growth or extension of the system. The possibility of locating sub-stations in newly-opened districts and operating them from the main station with a small line loss and small copper investment, gives the alternating system a distinct lead over the straight 500-volt direct-current system with its limited sphere of action.

In a large city system it is possible to interconnect the 500-volt feeder network so that during light night loads the outlying sub-stations can be shut down and the entire load thrown upon one or more centrally-located stations, thus operating some of the sub-stations with, perhaps, one shift of attendants.

Modern suburban cars operating at speeds between 40 and 50 miles per hour, consume nearly 100 kilowatts average for a 25-ton car, but demand two or three times this amount while starting or on severe grades. A direct-current generating station, supplying nothing but a suburban system operating upon half-hour headway, must sustain very violent fluctuations in load, resulting in a coal consumption in the vicinity of six pounds per kilowatt hour, when the same engines would probably run three and one-half pounds with a uniform load curve. The alternating-current system, by combining the load of several isolated generating stations upon one set of engines, smooths out these violent fluctuations, thereby producing a load curve upon which engines and boilers will operate economically.

There are certain railway projects calling for intermittent running of very large units, demanding a large local consumption of power over an extended line. Trains may not follow each other at sufficiently frequent intervals to warrant the operation of rotary converter sub-stations located at short distances apart, much less the installation of several isolated direct-current generating stations. Cheap water power privileges may be in the vicinity of the line, offering an excellent reason for electrically equipping the system, provided the first cost of installation and labor expenses of operating can be kept reasonably low.

The alternating-current induction motor has been in commercial operation for several years and is being manufactured in sizes of several hundred horse-power, starting with full load torque, or greater when used for such work as hoists, etc. The principles of its construction are well understood and it can be accurately designed for the work it has to do. A train propelled by induction motors presents some characteristics which are novel from a direct-current motor standpoint.

The speed of the train is fixed not by the voltage of the trolley, as in the direct-cur-

rent system, but by the frequency of the source of supply, which offers a much surer guarantee of maintaining a fixed schedule speed than the variable voltage supply of the direct-current system. The induction motor also has no commutator and offers certain advantages in the way of a better dissipation of losses than the direct-current motor, so that its adoption upon long trunk lines presents many advantages.

The main benefit secured by using induction motors on long lines having infrequent travel is the low cost of installation and of operation, due to the use of one or more generating stations feeding step-down transformers located along the line, which do not require more than casual inspection. The main transmission line may operate at 10,000 or 20,000 volts, or higher, depending upon the bulk of power and the distance to which it is to be transmitted, while the trolley or third-rail voltage being no longer confined by the limitations of the direct-current commutator, can be raised to several thousand volts if necessary, and, in fact, is only limited by the quality of line insulation. By raising the trolley voltage to several thousand volts it will not be necessary to install expensive third-rail construction, as the currents carried will be small and can be taken from overhead construction.

The alternating-current induction motor system thus offers a system where schedule speed can be maintained without respect to line drop or grades, which feature particularly recommends it for the equipment of suburban and trunk lines having no city connections where it will be necessary to operate cars over city streets.

The alternating system requires multiphase motors to insure good starting torque and to prevent loading up the lines with lagging or useless currents, and three wires being required it is undesirable to operate with a double trolley through crowded city streets. Suburban cars which pick up their passengers through the city have the advantage of providing a continuous passage from the heart of the city to the terminus of the road, while the induction-motor suburban road would require a transfer station at the outskirts of the city.

The induction motor system, therefore, appears best adapted for the operation of long suburban roads having no city connections, and especially those roads where heavy trains operate at infrequent intervals. By emphasizing this latter kind of road it is not intended to convey the impression that the induction-motor system is not equally well adapted for frequent service, but short headway is warranted only in crowded districts where the operation of rotary converter sub-stations would perhaps offer advantages in the distribution of 500-volt direct-current power for local railways.

RECAPITULATION.

In the foregoing discussion the attempt has been made to bring out the fact that the electric railway field has become so broad and includes so many different problems in railway engineering that no one system of distribution is adapted for all classes of service. A small, congested system, having its lines within easy reach of the power house, which enjoys good coal and water facilities, is distinctly a 500-volt direct-current system, or if it has suburban lines where the service is intermittently severe the station should include a series-wound booster in its equipment.

Larger systems, either city or suburban, where the power generated is large and must be transmitted over considerable areas, present the dividing line between the 500-volt direct-current system and the alternating-current sub-station system of distribution. Local details enter into the problem as so large a factor in the consideration of such roads that it is only possible to make the general statement that that system of distribution is the better in which operating expenses added to interest on copper investment and fixed charges figure out the lowest.

Suburban roads operating considerable lengths of track over which run heavy cars of 25 or 30 tons at speeds of 40 or 50 miles per hour can usually find in the alternating system a cheaper method of operation and a considerably cheaper first investment than will be the case if a number of comparatively small isolated direct-current stations were installed, or the attempt made to feed from a single direct-current generating station. The use of boosters in such direct-current stations for permanent operation must prove expensive and their operation will contrast unsatisfactorily with the service secured from rotary converter sub-stations fed from a single generating station well located.

The next class of service into which electricity has been entering in the last two or three years, the equipment of existing steam lines for suburban work and finally for trunk lines, calls for requirements which the alternating rotary converter system can not fulfill in many cases, owing to the infrequency of the trains. It may not be advisable in such roads to split up the large heavy trains into a number of smaller more frequent units, especially if these large trains carry freight, owing to the increase in the labor expense account.

The alternating induction motor system can operate heavy trains as a whole without increasing the large labor account by sub-station attendance and can further guarantee the maintenance of a fixed speed over an extended line independent of line voltage and grades, and irrespective of the number of trains moved, a feature which is the basis of the operation of such long-distance roads. Where the service is more frequent the dividing line between the induction-motor system becomes less sharp and local considerations may enter as the deciding factor in the adoption of one system or the other.

The system of distribution, like the railway motor itself, must be adapted for the work in hand, and, although the field of the three main systems overlap each other there are certain fundamental characteristics of each which particularly adapt them for the operation of their own specific class of service.

Electric Railways

Property owners' consents are being secured for an electric line from Springfield, Ohio, through Clifton, Cedarville and Jamestown to Hillsboro. The proposed line will be about 35 miles long.

Since it is a certainty that the electric line from Cleveland to Buckeye Lake, Ohio, is to be built, the state canal commission has had numerous applications for leases of the small islands for Summer residence purposes.

The Columbus, New Albany & Johnstown, Ohio, Traction Company claims it will be the first interurban to enter the city of Columbus of the many that are now building. It has contracted for its ties, poles and overhead work and will soon close deals for steel rails.

The Ripley Northern Railway, of Ripley, Brown County, Ohio, has been incorporated by: Ernst Bambach, E. E. Galbraith, John W. Adkins, G. R. Young, J. C. Newcomb, Albert White, P. D. Newcomb, J. S. Alward and J. E. Kirkpatrick. They propose to build an electric railway from Ripley to Hillsboro, a distance of about 30 miles.

Complications have arisen respecting the franchises of various interurban companies which have been granted permission to enter Columbus, Ohio. It now develops that a number of the roads have been granted franchises to lay double tracks on the same streets, and the confusion is necessarily great, and a source of annoyance to the companies.

The controversy which has waged in Columbus, Ohio, over the renewal of the Columbus Street Railway Company's franchise promises to develop into a campaign issue, and it is now claimed the street railway will attempt to name the next Mayor and dictate his cabinet. Neither the company nor the city officials seems willing to make any concessions whatever, and the fight continues.

Adam G. Grant, of the Grove City, Ohio, Electric Railway, has been granted a franchise by the county commissioners to extend his line from Grove City to Morgan's Station, a distance of about 12 miles. The franchise calls for the completion of the road in one year. The commissioners also extended the time of beginning work for the Columbus, Mechanicsburg & Urbana Electric Road from October 1, 1900, to Jan. 1, 1901.

SYSTEMS AND APPARATUS FOR LIGHT AND POWER DISTRIBUTION.*

BY CHARLES PROTEUS STEINMETZ.

It is with some hesitation that I undertake to speak on the problem of power distribution for lighting before an assembly of men who have made the solution of this problem their life work, but while I can not expect to offer much that is new, I shall endeavor to consider the problem from a somewhat different point of view. Having designed very many machines and apparatus of all kinds, watched their operation personally or with the eyes of others, and studied their nature theoretically and experimentally, I shall try to discuss in the following the nature and behavior of those apparatus which are of interest to you.

As you know, there is a considerable difference between satisfactory apparatus and satisfactory operation. A machine may be satisfactory, that is, it fulfills all the guarantees asked by the customer and given by the manufacturer, and when properly handled and taken care of, under reasonably fair conditions, it does its work and does it well. But the more you become familiar with it the less you are confident that you can rely upon it in any emergency, and that it will not go back on you just where you need it most. That is the feeling experience has given me regarding 60-cycle converters for instance. Other machines, again, the longer you operate them the more you become confident that you can rely on them under any conditions, normal or abnormal. This different behavior is inherent to the type of apparatus, equally good design and construction presupposed.

I shall not reopen the question of alternating or continuous-current distribution, since for your class of work experience has pretty well decided in favor of continuous current for most cases and relegated alternating current to pioneer work in outlying districts.

The usual system of light and power in larger cities is the continuous-current Edison three-wire system, supplied from a number of stations located in the centres of distribution, and operating direct-connected units, or pairs of 125-volt, face commutator machines. This type of machine has the advantage to be more economical in space than any other type, and thus is specially suited for this class of work where 125-volt machines are used; when using 250-volt machines the carbon brush, separate commutator type is generally employed.

Series arc lighting is done by belt-driven arc machines; outlying districts are supplied with alternating current by belted or occasionally direct-connected alternators.

In these stations the storage battery has been successfully introduced. It increases the station capacity by supplying power during the peak of the load, increases the economy by permitting to shut down smaller stations during times of light load, increases the distance feasible for power supply, and permits an almost unlimited supply of current for a short time. In this class of service, where abuse of the battery can be avoided, its depreciation is moderate, and its low efficiency, which probably does not exceed 70 to 80 per cent, is no serious objection, since the battery receives power when there is a surplus and returns it when power is most valuable.

The lesser economy of operating a number of smaller stations in unfavorable locations led to the desire of generating the power in one large station in favorable location outside of the city, by steam or water-power, and distribute it to the sub-stations.

The power is generated in one station by a number of large direct-connected three-phase alternators, transmitted at high voltage to sub-stations, and there transformed or converted into the different forms of power required, low voltage, continuous current for the main distribution, alternating for outlying districts and pioneer work, and constant current for arc lighting.

The first and most important question to be considered is that of frequency.

Incandescent lighting is feasible at 30, and satisfactory at 40 cycles.

Arc lighting is feasible at 40, and satisfactory at 60 cycles, but still better at 125 cycles.

Rotary converters are feasible at 60 cycles, but perfectly satisfactory only at 25 cycles.

In direct-connected, slow-speed, alternators the lowest frequency is the most desirable.

Where a continuous-current network is an important part of the system, and even where only a noticeable part of the power is to be transformed to continuous current, the rotary converter is the most efficient and reliable apparatus for use.

A number of converters are in satisfactory operation at 60 and even 66 cycles, under favorable conditions as regards steadiness of power supply, low resistance of transmission line, careful attendance of commutator and brushes, etc.

The converter, however, is essentially a commutating machine like the continuous-current generator, differing therefrom only in so far that it must run in synchronism with the alternating supply current.

The most essential part of the commutating machine, and that which under unfavorable conditions of operation or design is most troublesome, is the commutator. It is obvious that, the lower the peripheral speed of the commutator, the lower the volts per commutator bar, and the wider the commutator bars, the better is the commutator. Assuming thus as conservative values a width of bars of three-eighths inch, a peripheral speed of 3,000 feet per minute, and 8 to 10 volts per segment, values which, while higher than customary in the continuous-current generators with which you are familiar, are still within good and conservative practice under the favorable conditions existing in the converter (absence of armature reaction and high number of revolutions). At 250 to 300 volts, 8 to 10 volts per bar give 30 bars from brush to brush, and three-eighths inch width of bar then give a commutator pitch of 30 by three-eighths inch equals $11\frac{1}{4}$ inches, which is to be passed over during each half wave of the alternating current. At 3,000 feet per minute this gives $\frac{3{,}000 \times 12}{11\frac{1}{4} \times 60} = 53.3$ half waves, or about 27 cycles per second as the upper limit of conservative converter design. As comparison may be stated that the frequency of large, low-speed, direct-connected, continuous-current generators averages 8 to 12 cycles, and about twice this value in high-speed machines.

At 60 cycles, where the commutator has to move the distance from brush to brush in 1-120 of a second, conservative design of the commutator is not possible any more, and such machines thus are satisfactory only under favorable conditions of operation, although it must be conceded that the voltage of 250 is relatively the best suited for 60-cycle converters.

The converter necessarily is a multipolar machine, and the number of poles must be the larger, the higher the frequency. This requires that the armature reaction of the machine, considered as continuous-current generator, must be high, to avoid cross currents between the poles and unequal current distribution between the different sets of brushes of equal polarity, and consequent heating and sparking. Due to the unavoidable inequalities of the different poles the voltages induced thereby are more or less different, and this difference has to be compensated by the magnetizing effect of the armature reaction. For instance, in the face commutator machines, with which you are familiar, you will find, by disconnecting the brushes from each other, differences of voltage between different poles amounting in extreme cases to 10 per cent or more. With the very high armature reaction of these machines, a very slight difference of current takes care of this inequality, but with a machine of very low armature reaction, as the 60-cycle converter (in which the space per pole on the armature surface is limited by the frequency) unequal current distribution may become serious. This feature is the cause why in double-current generators close regulation is not permissible by good design.

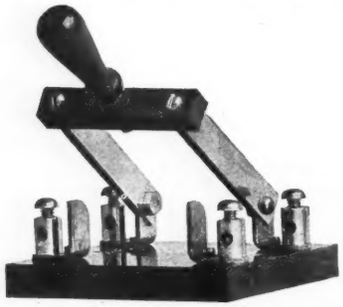
The higher the frequency the greater must necessarily be the peripheral speed of the armature of the converter, and the greater thus its momentum. High momentum, however, predisposes to hunting directly as well (the momentum entering as terms in the equations of hunting) as indirectly, by making the machine less liable to follow slight pulsations of frequency as due to the pulsation of the engine speed.

(To be continued.)

*Read before the Association of Edison Illuminating Companies, Saratoga, N. Y., September 4, 1900.

A Novelty in Switches.

The accompanying illustration represents an ingenious new form of two-pole switch which combines several features of novelty and merit. The blades of the switch are made each of a single piece of copper bent into the form of an inverted U and arranged so as to enclose the stationary post upon which they turn and also to grasp between their inner sides the con-



A Novelty in Switches.

tact clips. The manufacturer, the Springfield Electrical Manufacturing Company, of Springfield, Mass., states that several joints in the circuit have been eliminated by this peculiar design, and that the bending of the copper used in the blades makes these latter very rigid. Since the posts are also made in one solid piece there are no rivets or solder used in the construction of the switch, thus leaving less chance for loose and faulty connections. The switch is known as the "Curtis" type. It is made by the company mentioned above in a number of different sizes.

Some Holiday Electrical Specialties.

At this season of the year people naturally begin to turn their attention toward Christmas and Christmas gifts, and the

Small Battery Motor.

live boy who is in his early teens wants electrical machinery that, while it is not exactly of the toy kind is yet small enough for him to experiment with and good enough to work and run small machinery. To meet this kind of demand the little motor which is here illustrated, and which is aptly called the "Little Hustler," has been devised by the Knapp Electric Novelty Company, of New York city. The design has been considerably improved. The base has been made heavier, a name-plate has been added and the machine is now finished in black enamel with nickel trimmings. The motor has a three-pole armature, and, hence, it has no dead point, and will start as soon as current is turned on. It drives a five-inch fan at high-speed and is provided with a pulley for running mechanical toys and models. When used for this kind of work one ordinary-size dry cell is all that is necessary to operate it. The same concern also manufactures what is known as an electric "Thriller" which is arranged so that it can give shocks of any strength desired. An instrument similar to the thriller but heavier and stronger in its parts and known by the suggestive name of "Shocko" is also made by the Knapp Company. This is operated by a dry cell and contains carefully finished and well-made induction coils so that it is possible to give very violent shocks with it. A special feature that is claimed by the manufacturer for all these goods is their careful workmanship and high finish.

A New Type of Automobile Trap.

The illustration herewith shows a new form of electric vehicle intended to carry four persons, built upon lines which combine several valuable departures from ordinary practice. The long wheel base of the vehicle is especially notable, this insuring great stability as the machine runs along and permitting high speeds. It will be noticed from the illustration that the machine is equipped with two motors and has large battery space. The controller gives five speeds forward, varying up to 14 miles per hour, and three speeds backward. The "trap" is equipped with both electric and foot brakes and its maker, the National Automobile and Electric Company, of Indianapolis, Ind., claims that it has a radius of action exceeding 40 miles on one charge of battery.

An Electromobile Four-Seated Trap.

Telephone and Telegraph

The Bell Telephone Company will erect a modern telephone building in East Liverpool, Ohio. The building will be a three-story brick, with the telephone offices on the first floor and the underground system will be used.

The New Citizens' Telephone Company, which was installed in Cleveland, Ohio, last April, was visited by the state board of appraisers and assessors, recently, on a tour of inspection. The authorities feel inclined not to appraise it for taxation purposes this year on account of the lateness of its establishment.

A telephone company has just been organized as Sioux Rapids, Iowa, composed of the following local business men: Messrs. P. J. Cilley, R. H. Hulett, A. Tymeson, Jr., and W. B. Mills, to operate and maintain a local telephone line in Sioux Rapids. The line will be built and put in operation in less than sixty days. The company will be incorporated under the name of Sioux Rapids Telephone Company.

The directors of the Citizens' Telephone Company, of Racine, Wis., have elected the following officers: President, John B. Simms; vice-president, E. B. Belden; secretary, J. Breese; treasurer, Charles Carpenter. The contract for the construction of the system was awarded to Jones & Winter, of Chicago. They will get about $56,000 for the work. The work of construction will commence September 30, and the plant will be in operation about January 1.

Two Paris Medals.

The New York & Ohio Company, of Warren, Ohio, received an award of two medals at the Paris Exposition for the excellence of its Packard lamps and transformers.

SUDDEN DEATH OF JOHN E. HUDSON.

FOR THIRTEEN YEARS PRESIDENT AND GENERAL MANAGER OF THE AMERICAN BELL TELEPHONE COMPANY.

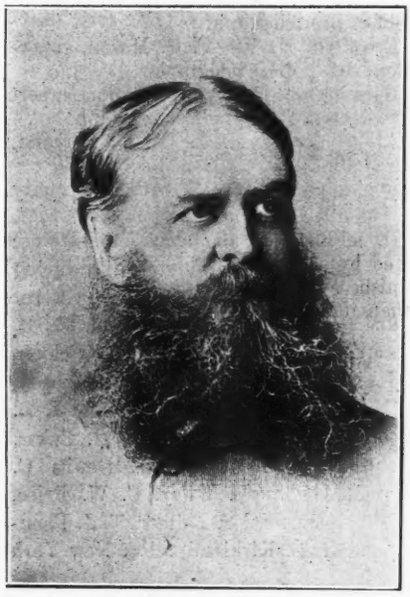
John Elbridge Hudson, president of the American Bell Telephone Company, died suddenly in the railroad station at Beverly, Monday, October 1, while waiting for the 9.11 train to Boston. Mrs. Hudson and he were sitting together in the waiting room when Mr. Hudson threw up his hands and slipped to the floor. He was lifted at once and laid on a seat; but it was plain to everyone that he was dead. When the doctor arrived at the station a few minutes later he ascribed the death to heart disease. The body was taken at once to his Summer residence—the Claflin House, at Hospital Point.

Mr. Hudson had been president of the American Bell Telephone Company for 11 years, and has been connected with the company for 20 years. During his presidency the greatest development of the company has taken place. Primarily a lawyer, Mr. Hudson has concerned himself chiefly with the business and executive management of the company. Under his direction, assisted by Mr. E. J. Hall as general manager, the long-distance service was perfected.

Mr. Hudson was born in Lynn, on August 3, 1839. He was a descendant of Thomas Hudson, who came from England in 1630 and settled in the Massachusetts Bay Colony. Thomas was of the same family as Henry Hudson, the navigator, who sailed his ship up the river which now bears his name. It was on Thomas Hudson's land in Saugus, rich in iron ore, that the first iron works in this country were established. The very first iron casting, made in 1642, remained in the possession of descendants of Thomas Hudson until 1893, when Mr. John E. Hudson made a present of it to the city of Lynn.

Mr. Hudson went from Lynn to Harvard College, where he was graduated in 1862. In college he was the first scholar of his class. After graduation he studied law at Cambridge, and entered this profession and became distinguished as a scholarly lawyer. Mr. Hudson was considered one of the finest Greek scholars in the United States, and was a great lover of the arts and sciences.

On the formation of the American Bell Telephone Company, in 1880, Mr. Hudson became office counsel for the company, and gradually withdrew from other practice. In 1885 he was made general manager. Two years later the duties of vice-president were added to those of general manager, and, in 1889, he was chosen to succeed Howard Stockton as president of the company. He has held that great office ever since with distinction. In his work he was untiring. As well as the American Bell Company, Mr. Hudson was president of the American Telephone and Telegraph Company, commonly known as the Long-Distance Company, which has recently taken over the American Bell Telephone Company.



JOHN ELBRIDGE HUDSON.

Mr. Hudson was a member of many clubs and societies. He married Miss Eunice W. Healey, of Hampton Falls, N. Y., who survives him.

The funeral was held at Beverly, Mass., at noon, Wednesday. Among the New York telephone men present were: E. J. Hall, Chas. F. Cutler, U. N. Bethell and W. D. Sargent.

The Bell Telephone Company, of Philadelphia, has granted its stockholders the privilege of paying in three instalments, on November 19, January 18 and March 18, for the new $1,000,000 issue of stock. The money subscribed, as well as the first $1,000,000, which makes the $2,000,000 authorized by the shareholders in March, will be used for betterments. The scheme now on foot is to provide a plant which will serve not only the 14,000 present subscribers, but 26,000 more, which the company expects to gain in the next few years. The company's gross receipts have materially increased over those of a year ago, but the net earnings, owing to expenditures, have been less than those of last year. It is claimed that the company has been earning enough to pay the eight per cent dividend regularly.

Wall Street and the Electrical Stock Market.

Perhaps the word nervousness is the best to use in describing the condition of the market for the last week. While it is admitted by every thinking and cool-headed observer that the future of American securities has never rested on a more solid basis, at the same time such extraneous disturbances as the political campaign, just beginning to be waged in earnest, and the prolonged coal strike, are having their customary influence. At the same time, the placing here of foreign government loans is a sufficient indication that this country enjoys a heavy credit balance abroad.

On the New York Stock Exchange, General Electric closed the week at 134½ bid and 135 asked, showing a gain of 1½ points for the week. Metropolitan Street Railway, of New York, closed at 147½ bid and 148 asked, showing a gain of 1 point for the week, which indicates a movement to offset the decline which this stock has suffered for the past two or three weeks. Third Avenue Railroad, of New York, closed at 108½ bid and 109 asked, showing a decline of ¼ point. This stock has now declined 2½ points in three weeks. Brooklyn Rapid Transit closed at 50⅝ bid and 50¾ asked, showing a gain of ½ point. Manhattan Railway, of New York, closed at 86½ bid and 86¾ asked, showing a gain of 1½ points for the week.

On the Boston exchange, American Telephone and Telegraph closed at 135 bid and 137 asked, showing a decline of 2 points. Erie Telephone closed at 96 bid and 97 asked price, having remained stationary for the week at this quotation.

On the Philadelphia exchange, Electric Storage Battery was not quoted. Electric Company of America closed at 8¼ bid and 8½ asked, showing a gain of ¼ point. Union Traction closed at 29⅜ bid and 29½ asked, showing a decline of ⅞ point for the week, or 7⅜ points for the last three weeks.

On the curb, or outside market, in New York, Electric Vehicle closed at 19½ bid and 22 asked, showing a gain of 2½ points for the week. Electric Boat closed at 13 bid and 17 asked, showing a decline of 2 points for the week.

Wall street, September 29.

The expected war between the independent and Central Union Telephone companies has broken out at Portsmouth, Ohio. The Central Union announces that next week it expects to cut the rate for residence telephones to 50 cents per month.

MUNICIPAL ELECTRICIANS.

CONCLUSION OF THEIR ANNUAL CONVENTION AT PITTSBURGH—NIAGARA FALLS NEXT MEETING PLACE—MR. MORRIS W. MEAD ELECTED PRESIDENT.

The concluding sessions of the International Association of Municipal Electricians, at Pittsburgh, last week, were as full of interest and well attended as at the opening, which was chronicled in the ELECTRICAL REVIEW last week. The meetings were presided over by President Wm. Brophy, and M. G. Canfield, of Grand Rapids, Mich., served as secretary.

Wednesday papers were presented by J. L. Morgan, of Kansas City; F. C. Mason, of Brooklyn; M. G. Canfield, of Grand Rapids, Mich.; Charles Berger, of Boston, and W. H. Baker, of New York. These papers were discussed at some length. Among the addresses was one by Mr. D. R. Walker, chief of the electrical bureau of Philadelphia, who spoke at some length concerning the work of his bureau.

On Thursday the officers were elected as follows, Niagara Falls, N. Y., having been previously selected as the next meeting place:

President, Morris W. Mead, Pittsburgh, Pa.

First vice-president, J. T. Zeliff, Paterson, N. J.; 2d vice-president, B. McAllister, Bradford, Pa.; 3d vice-president, R. E. Moran, Memphis, Tenn.

Secretary, F. P. Foster, Corning, N. Y.

Treasurer, Adam Bosch, Newark, N. J.

Executive Committee: M. J. Donaghue, Niagara Falls, N. Y.; Captain William Brophy, Boston; J. W. Aydon, Wilmington, Del.; Frank C. Mason, Brooklyn, N. Y.; F. G. Boyd, Baltimore, Md.; W. Y. Ellett, Elmira, N. Y.; G. F. Macdonald, Ottawa, Ont.; M. G. Canfield, Grand Rapids, Mich., and F. L. Michaels, Peoria, Ill.

The convention adjourned Thursday noon, a meeting of the Executive Committee being held in the afternoon. The attendance was the largest in the history of the association and much interest was taken in its proceedings. Among the representatives from the different cities were the following:

Ottawa, Ont.—G. F. Macdonald, city electrician.

Toronto, Can.—J. S. Craig, superintendent fire-alarm telegraph.

Peoria, Ill.—F. L. Michaels, superintendent fire-alarm telegraph.

Corning, N. Y.—F. P. Foster, superintendent fire telegraph.

Baltimore, Md.—Frank G. Boyd, superintendent police and fire-alarm telegraph.

Grand Rapids, Mich.—M. G. Canfield, superintendent fire alarm.

Newark, N. J.—Adam Bosch.

Cleveland, Ohio—Jerry Murphy, superintendent fire telegraph.

Philadelphia, Pa.—D. R. Walker, chief of electrical bureau.

Allegheny City, Pa.—Elmer Loomis, superintendent fire-alarm telegraph.

Harrisburg, Pa.—J. Diehl, superintendent fire telegraph.

Boston—William Brophy, inspector.

Pittsburgh, Pa.—Morris W. Mead, superintendent bureau of electricity.

Erie, Pa.—William Crane, superintendent fire telegraph.

Elmira, N. Y.—W. Y. Ellett, superintendent fire telegraph.

Brooklyn, N. Y.—F. C. Mason, superintendent police telegraph.

Wilmington, Del.—J. W. Aydon, superintendent fire and police telegraph.

Atlantic City, N. J.—A. C. Ferrand, superintendent fire-alarm telegraph.

Rochester, N. Y.—L. W. Miller, city electrician.

In addition to the above, there were many visitors from different cities during the convention. Among these were: John P. Barrett and son, and E. B. Chandler, of Chicago; Charles Selden, of Baltimore; Messrs. George T. Manson, A. H. Patterson, Frederick Pierce, J. B. Taltavall, Alex Henderson, C. O. Baker, Jr., General C. H. Barney, Dewitt C. Bunnell, George L. Wiley, C. W. Price, J. Jones, Jr., Fred S. Palmer, T. J. Fleming and H. B. Kirkland, all of New York city.

Visitors were given handsome badges, some of which carried a picture of Fort Pitt, and all of which had the photograph of the Hon. Chris Magee, of Pittsburgh. It was greatly regretted that the poor health of Mr. Magee prevented his attendance. Mr. Cyrus O. Baker, Jr., the well-known platinum importer and refiner, was a welcome visitor to the convention, and was compelled to relate several times his exciting adventures at Honolulu some time ago in escaping before the Islands were quarantined. Mr. A. H. Patterson, of the Phœnix Glass Company, sent as souvenirs to all the delegates and ladies a number of very beautiful Jacob's ladders. They were much sought after by everyone. Mr. George T. Manson, of the Okonite Company, of New York, gave away an attractive souvenir, an aluminum cigar-ash receiver, bearing the famous trade-mark of his company. The gaiety of the occasion was also added to by the disbursement, by Mr. Manson, of a number of winged arrows carrying a sticking burr. These were a source of much merriment. Other interests were represented, among these being the Standard Underground Cable Company, who gave quite an exhibit of their electric wires and cables, and were represented by George L. Wiley, of New York, and a staff of Pittsburgh officials. Alexander Henderson represented the Sprague Electric Company, of New York; William C. Banks, Gordon Battery Company; William C. Callman, the Baines Primary Battery Company, of New York; Dewitt C. Bunnell, Bunnell Telegraphic and Electrical Company, of New York; James Jones, Jr., J. Jones & Son, of New York; Fred Pierce, electrical specialties, of New York; C. W. Price and Fred S. Palmer, the Montauk Multiphase Cable Company; General C. H. Barney, the Monarch Fire Appliance Company, of New York; O. W. Uthoff, the Columbia Incandescent Lamp Company, of St. Louis; H. B. Kirkland, of New York, James Wilson, of Boston, and Thomas G. Grier, of Chicago, the American Circular Loom Company, Boston; F. E. Donoghue, American Electrical Works, Providence, and John T. McRoy, the McRoy clay conduits. The *Telegraph Age*, of New York city, was represented by J. B. Taltavall, and the ELECTRICAL REVIEW, of the same city, by Charles W. Price.

The entertainment provided by the city of Pittsburgh was very elaborate and enjoyable, including visits to the park, theatrical entertainments, a boat ride with luncheon and supper, a visit to the Carnegie works and the scene of the Homestead strike. By special invitation of Mr. Geo. Westinghouse, the immense works of his company were visited and several hours were spent going through them. Refreshments were served and the visitors were handsomely entertained by Messrs. H. G. Welsh, Joseph W. Laury and Thomas Cope. The delegates and visitors participated in an enjoyable love feast Thursday evening, at the Monongahela House, the headquarters of the association, in which Pittsburgh and the new president were often toasted. The election of Mr. Mead as president met with universal commendation. Mr. Mead has been very active in the work of the association, and fully deserves the honor thus given him.

Honors for Mr. George G. Ward.

Mr. George G. Ward, of New York, has been decorated by the Emperor William, of Germany, with the Order of the Crown of the second class. Mr. Ward is the vice-president of the German Atlantic Cable Company and was present at the banquet recently given by that company, in Berlin, to commemorate the opening of its cable to the United States. Mr. Ward, who is the general manager of the Commercial Cable Company, has been traveling abroad with his family for several months.

Insulated Bridle Rings.

In the illustration herewith is shown in full size an enamelled insulated bridle ring designed for carrying telephone wires along the walls of buildings and distributing them to subscribers' offices or stations. The device is made of the best quality of drop-forged iron and is heavily enamelled. As the illustration clearly shows, it is made in the form of a screw eye with the circular part split, giving an opening one-quarter inch wide to receive the wire. New wires must be readily inserted and old wires removed from these rings without injury to either wires or insulators. An advantage claimed in the use of this device is that the rings may be easily installed in difficult and out of the way places and when it is desired may be unscrewed and used again for other work. These rings are made by James S. Barron & Company, 24 Hudson street, New York.

INSULATED BRIDLE RING, FULL SIZE.

Judge J. H. Thomas, manager, and James B. Hoag, secretary of the United States Telephone Company, of Cleveland, and Judge Wagner and K. F. Briggs, of Tiffin, all of whom are directors of the Findlay Home Telephone Company, recently held a meeting in Findlay, Ohio, for the purpose of completing arrangements for the building of a first-class plant there.

Articles of incorporation have been filed by the Buchanan County, Iowa, Telephone and Telegraph Company. Local parties are the stockholders. The system will be run underground, but the city of Dubuque will not be generally connected until Spring.

A Standard Form of Water-Wheel Governor.

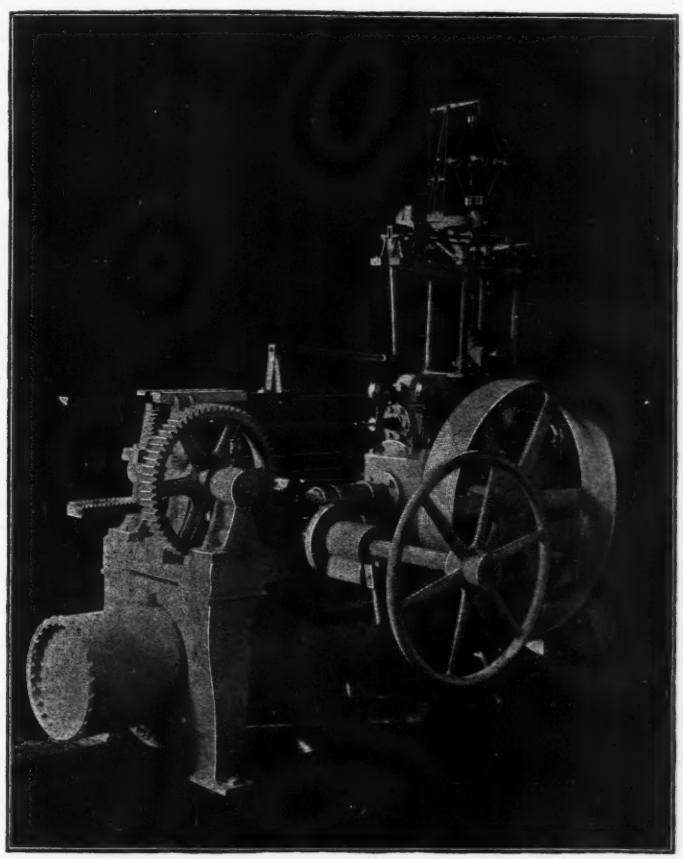
The accompanying illustration shows the standard form in which the Lombard water-wheel governor is now manufactured.

This design is the result of applying governors to more than 200,000 horsepower of water-wheels working under a great variety of conditions. The manufacturers claim that it is dead-beat, unless the hydraulic conditions under which the water-wheels are set are very bad, and even under the most unfavorable conditions, that it will move the water-wheel gates to the correct position in a few seconds without racing. Under good hydraulic conditions it is possible for circuit breakers to open under full load without materially disturbing the speed.

This type of governor will develop 10,000 foot-pounds in two seconds on the gate rigging, which amount of energy is sufficient to handle the gates of the largest water-wheel units found in practice. It is being used in some of the largest and most difficult water-power plants now in operation; as for example, the St. Anthony Falls Water-Power Company, of Minneapolis; the Lachine Rapids Hydraulic and Land Company, of Montreal; the Hudson River Water-Power Company, of Mechanicsville, N. Y.; the Great Northern Paper Company, of Millinocket, Me., and the Fries Manufacturing and Power Company, of Salem, N. C. It is also being installed in such plants as the Sao Paulo Tramway, Light and Power Company, of Brazil; the Boston & Montana Copper and Silver Mining Company; the Canadian Electric Light Company, of Levis, Quebec; the Virginia Electric Railway and Development Company, of Richmond, Va.; the Empire State Power Company, of Amsterdam N. Y.

The above plants, which are only a few of those where this type of governor is either in use or being installed, have been referred to as they cover a great variety of conditions, both as to hydraulic design, make of water-wheels and variety of load. The other eight types of governor manufactured by the same company are modifications of the type shown, and range from the little type F for tangential water-wheels, to type G, in use at Niagara Falls and elsewhere to regulate very large water-wheels under high head.

These governors are made by the Lombard Water-Wheel Governor Company, of Boston, which quarantees them to give the most accurate speed regulation attainable.



STANDARD TYPE OF LOMBARD WATER-WHEEL GOVERNOR.

The American Electro-Therapeutic Association.

The tenth annual meeting of the American Electro-Therapeutic Association was held in New York city, September 25, 26 and 27, at the Academy of Medicine. An interesting programme was presented, many papers of considerable value read and a large attendance was present, indicating both the increasing interest taken in the medical applications of electricity and the continued growth and increasing influence of the association itself.

The first day's meeting was opened by an executive session at 9 o'clock in the morning, followed by a scientific session at 10 o'clock. Before the latter the Hon. Randolph Guggenheimer, acting Mayor of New York, made an address of welcome which was followed by addresses by Dr. L. T. Bishop, secretary of the Academy of Medicine, and the Rev. Newman Lawrence. After the reading of several reports the reports of standing committees on scientific questions were presented as follows:

"On Induction Coils and Alternators," by Margaret A. Cleaves, M.D., chairman, New York.

"On Meters," by Emil Heuel, M.D., chairman, New York.

"On Static Machines and Condensers," William J. Morton, M.D., chairman, New York.

"On Constant-Current Generators and Controllers," by William J. Herdman, M.D., chairman. Report included "Dry Batteries for Electro-Therapeutic Use."

"On Electrodes," by Charles R. Dickson, M.D., chairman, Toronto.

"On Electric Light Apparatus for Diagnosis and Therapy and the Roentgen X-ray," by Professor Amos E. Dolbear, M.A., Ph.D., chairman, Tufts College, Mass.

"On Cataphoresis," Mr. J. J. Carty, E.E., chairman, New York.

At 2 o'clock in the afternoon a visit by the members of the society was made to the headquarters of the New York Electric Vehicle Transportation Company, and at 3 o'clock a visit was made to the Cortlandt street telephone exchange of the New York Telephone Company.

The afternoon session was called to order at 4 o'clock for the reading and discussion of papers. As a subject for discussion was chosen "Electricity in Tuberculosis and Present Modes of Treatment." An evening session was also held at 8 o'clock, where a number of interesting papers were presented. Among these was one by Mr. E. W. Caldwell, in which he exhibited a number of new appliances for practical X-ray work.

The second day's session was also preceded by an executive session, the general meeting being held at 10 o'clock. At this a subject of more particularly medical interest was discussed and a number of papers presented bearing upon the more specifically medical aspects of electro-therapeutics. At 2 o'clock P. M., a visit was made to the Metropolitan power house at Ninety-sixth street and First avenue, and later in the day members visited the Brooklyn Bridge and inspected its cable machinery at the invitation of the chief engineer, Mr. Martin. The afternoon session at 4 o'clock was given over to the reading of papers, among them being several of general electrical interest. This particularly applies to the paper on a new form of fluid interrupter for direct current, by Dr. Emil Heuel, and concerning coils for use with heavy currents by Dr. R. J. Nunn. In the evening an executive session was held at 8 o'clock for the annual election of officers, and at 9 o'clock several papers that had been omitted from the programme of the preceding sessions for one reason or another were read. A paper entitled "Methods of Generating and Transforming Electric Current for Therapeutic Uses," by Mr. C. T. Child, was also read at this session and will be found in another column.

The third day's session was given over to a number of papers bearing particularly upon the practical work of the electro-therapeutists. The afternoon of this day was spent in visits to various points of interest about the city.

The following officers were chosen for the current year: President, Dr. Ernest Wende, of Buffalo; 1st vice-president, Dr. F. H. Morse, of Melrose, Mass.; 2d vice-president, Dr. D. R. Brower, of Chicago; secretary, Dr. G. G. Bill, of Harrisburg; treasurer, Dr. R. G. Nunn, of Savannah; chairman executive committee, Dr. Francis G. Bishop, of Washington. The next annual meeting will be held in Buffalo, beginning the first Tuesday in September.

BOOK REVIEW.

"Electricity Made Simple." By Clark Caryl Haskins. Paper. Five by six and one-half inches; 233 pages, 108 illustrations. Published by Clarence Macdonald, Chicago, 1900. Supplied by the ELECTRICAL REVIEW at 50 cents, or $1.00 in cloth binding.

This book, which is a convenient size for the pocket, is dedicated by the author to his "many friends in blouse and overalls." It is written for the practical man who is neither instructed to understand nor interested in the scientific working out of electrical theory, but who does want to know the facts about the matter. The author has been exceedingly successful in his effort to produce a book of this kind, and has made one that will be found interesting reading to others than those for whom it is intended. While there have been many elementary books about electricity written there have been very few that are simple enough for the comprehension of the layman, and at the same time not childish and written down to the level of what is supposed to be a boy's understanding. It is pleasant to see a book written for men and written in a plain, practical, everyday, easy kind of way that will be appreciated by those who read it. Mr. Haskins's book deserves to be a success, and we believe it will be.

Corporation News

WILMINGTON, DEL.—The New York, Philadelphia & Norfolk Telegraph and Telephone Company, of Wilmington, Del., has been incorporated; capital, $150,000.

PIERRE, S. D.—Articles of incorporation have been filed for the New Hampshire Lighting Company, at Pierre, with a capital of $200,000; incorporators: Don L. Clark, G. V. Pattison and Charles C. Corbett.

FARMLAND, IND.—The Farmland Telephone Company, of Farmland, has been incorporated to operate telephone lines. Capital, $10,000; incorporators: T. W. Botkin, W. C. West, H. D. Good, J. T. Wright, J. Nixon, all of Farmland.

SCHENECTADY, N. Y.—The General Electric Company has declared a dividend of two per cent on common stock, an advance of one-half per cent from the last previous payment. The dividend is payable October 15 to stockholders of record September 25.

WARSAW, IND.—The Commercial Telephone Company, of Warsaw, has been chartered to build lines and operate exchange. Capital, $30,000; incorporators: J. A. Widaman, O. Oldfather, C. M. Burkett, S. W. Chipman, C. E. Wahl, M. R. Williams, all of Warsaw.

BROADALBIN, N. Y.—Broadalbin Electric Company, to furnish light, heat and power for the village of Broadalbin. Capital, $25,000; directors: Henry B. Dakman, E. H. Tucker and T. Arthur Farley, Brooklyn; L. U. Shafter, Rockville Centre, L. I.; Charles F. Lehmann, Smithtown, L. I.

SYRACUSE, N. Y.—The Archbold-Brady Company, of Syracuse, has been incorporated to construct street surface railroads, electric lighting plants, telephone, telegraph and gas plants. Capital, $50,000; directors: William K. Archbold, Paul T. Brady and Robert E. Drake, of Syracuse.

READING, PA.—A charter has been issued by the state department at Harrisburg to the Oley Valley Railroad Company, to build a line from Reading to Boyertown. Capital, $200,000. John A. Rigg, of Reading, is president. The new line will be affiliated with the United Power and Transportation Company, which owns the lines in Reading.

NEW YORK CITY—Justice Truax has granted an order dissolving the firm of the Schmidt & Bruckner Electric Company, of 135 Elm street, and appointed Lambert Schmidt permanent receiver. Mr. Schmidt was appointed temporary receiver on June 5 in a suit brought by Frederick C. Bruckner against Lambert Schmidt for a dissolution of the copartnership on account of a disagreement between them.

ONE NIGHT TO KANSAS CITY.

SPECIAL TRAIN TO AMERICAN STREET RAILWAY CONVENTION LEAVES NEW YORK AT 10 A. M., OCTOBER 14, ARRIVES KANSAS CITY 9.30 P. M., OCTOBER 15 —A FINE CONVENTION ASSURED.

The conventions of the American Street Railway Association are representative in character of attendance and in exhibition of equipment. The interests involved are so vast and the improvements and advancements so numerous that the leading street railway men of the country find it of the greatest importance to attend these annual gatherings and have their engineers and electricians attend.

The convention to be held in Kansas City week after next promises to be as successful as any of its predecessors, notwithstanding it is held farther west than ever before. The programme promises a number of practical and thoughtful addresses and consequent discussion. Among the addresses are the following:

"Comparisons of the Various Systems of Electrical Distribution for Street Railways."

"Double Truck Cars; How to Equip Them to Obtain Maximum Efficiency Under Varying Conditions."

"Consolidation of Street Railways and Its Effect Upon the Public."

The special train from New York city has been scheduled as follows, and it is expected that it will leave New York state with at least 100 passengers:

Lv. New York	N. Y. C.	10.00 A. M.	Sunday,	Oct.	14.
" Poughkeepsie	"	11.45 A. M	"	"	"
Ar. Albany	"	1.20 P. M.	"	"	"
Lv. Albany	"	1.30 P. M.	"	"	"
" Schenectady	"	2.00 P. M.	"	"	"
" Utica	"	3.40 P. M.	"	"	"
" Syracuse	"	5.05 P. M.	"	"	"
" Rochester	"	6.50 P. M.	"	"	"
Ar. Buffalo	"	8.35 P. M. (E. T.)	"	"
Lv. Buffalo	L. S. M. S.	7.40 P. M. (C. T.)	"	"
" Erie	"	9.40 P. M.	"	"	"
" Cleveland	Big Four	12.10 A. M.	Monday,	Oct.	15.
" Indianapolis	"	8.00 A. M.	"	"	"
Ar. St. Louis	"	1.50 P. M.	"	"	"
Lv. St. Louis	Wabash	2.15 P. M.	"	"	"
Ar. Kansas City	"	9.30 P. M.	"	"	"

The train will consist of baggage, smoking and Pullman vestibuled drawing-room sleeping cars, and dining-car serving meals through to Kansas City. A special representative of the New York Central will accompany the party to Kansas City.

The special rate of one and one-third fare on the certificate plan has been made, and delegates, when purchasing tickets, should ask ticket agent for certificate, which, on presentation at Kansas City, will secure one-third fare for the return trip. Sleeping cars at regular rates.

The committee in charge asks that all who take the train at New York, or stations on the New York Central & Hudson River Railroad, communicate with Milton C. Roach, general eastern passenger agent, New York Central & Hudson River Railroad, 1216 Broadway, New York, stating exact accommodations required and from what point.

Among those who have already arranged to go on the special train are the following: H. H. Vreeland, president of the Metropolitan Street Railway Company, M. G. Sterratt, chief engineer of the Metropolitan Street Railway Company, and a number of staff officials; Clinton L. Rossiter, president of the Brooklyn Rapid Transit Company, and several others of his staff; Hartford, New Haven and Bridgeport, Ct., and New Jersey street railway officials.

In addition to the above street railway men who start from New York it is expected that quite a New England delegation will come over Saturday night and start either from New York city or join the party at Albany. Many of the electric railway men at the cities along the route, such as Albany, Utica, Rochester and Buffalo, have asked for reservations and will join the train at those cities. At Schenectady about a dozen officials of the General Electric Company will join the party.

Among others who expect to go from New York city are: A. M. Young, president of the Albany & Hudson Railroad; J. C. Gilbert and George S. Whipp, of the Merritt Electric Air Brake Company; J. H. Carson, of the Sterling-Meaker Company; F. G. Bolles, of the Bullock Electric Manufacturing Company; W. L. Candee and George T. Manson, of the Okonite Company; James P. McQuaide, of the National Conduit and Cable Company; John T. McRoy; General C. H. Barney, the Monarch Fire Appliance Company; John A. Brill and W. H. Heulings, Jr., of the J. G. Brill Company; James H. McGraw, of the *Street Railway Journal;* Charles W. Price and Stephen H. Goddard, of the ELECTRICAL REVIEW; J. M. Wakeman, of the *Electrical World;* Lieutenant F. W. Toppan, U. S. N., of the Bay State Traction Company; Joseph R. Ellicott, of the Standard Air Brake Company; H. M. Littell, former president of the American Street Railway Association; J. H. Meek, of the H. W. Johns Manufacturing Company; Elmer P. Morris, of the Morris Electric Company; Frank MacGovern, of Rossiter, MacGovern & Company; Major H. C. Evans, of the Lorain Steel Company; E. J. Lawless, of the American Car Company; A. J. Coffin, of the Joseph Dixon Crucible Company; W. M. Scott, of the Cutter Electrical and Manufacturing Company.

CABLE STEAMSHIP STRANDED.

THE CABLE SHIP ORIZABA, LAYING THE ALASKAN CABLE, AGROUND ON AN UNCHARTED REEF—DELAY IN CABLE OPERATIONS—NO LOSS OF LIFE.

Information has just been received that on the afternoon of September 20 the Pacific Coast Steamship Company's steamer Orizaba, while engaged in laying a cable from St. Michael to Unalaklik, Alaska, ran upon Rock Point Reef, St. Michael's Island, and at last accounts is still aground there. News of the disaster was brought by the steamship Ohio to Tacoma, Wash., and vessels have been sent to the rescue of the wrecked steamer. It is expected that they will take off the crew and the cable material and apparatus if this is possible.

General A. W. Greeley, chief of the United States Signal Service, was on board the Orizaba when she went on the rocks, and returned on the Ohio. He says that the master of the stranded steamer is of the opinion that she can be saved. General Greeley telegraphed to Mr. W. R. Brixey, of New York, who manufactures the Kerite cable, as follows:

"Orizaba grounded twentieth on apparently uncharted rock. No further details until about October 8."

In a press despatch from Tacoma, General Greeley is quoted as saying that the mishap will prevent the completion of the Behring Sea cable this year. The work was being done under contract by Mr. Brixey, and the plans for the cable were fully described in an article in the ELECTRICAL REVIEW on August 8, 1900. Mr. George F. Porter, who left New York to accompany the expedition for laying the new cable, is supposed to be on board the Orizaba. It appears that when the accident happened some four or five miles of cable had been laid out from St. Michael. It was intended to connect St. Michael, Unalaklik and Cape Nome by means of this cable, the whole length of it being 187 miles.

The Steubenville, Ohio, Traction Company expects to have its line completed to Alikanna by the first of next July.

The Columbus, Mt. Sterling & Washington, Ohio, Electric Railway Company was incorporated recently. The line will extend from Washington Court House through Bloomingburg, Madison Mills, Cooks and Mt. Sterling to Columbus, a distance of 40 miles. The enterprise is backed by James M. Wilson, of Chicago, and other Columbus capitalists.

Industrial Notes

THE STERLING ELECTRIC MOTOR COMPANY, Dayton, Ohio, is placing on the market a series of small power motors of variable speed and variable power produced in one frame.

ERICSSON TELEPHONE COMPANY, 296 Broadway, New York city, has been receiving so many orders for its Ericsson Swedish telephones that it has been compelled to add an extra force of employees to carry them cut.

COLLYER INSULATED WIRE COMPANY, Pawtucket, R. I., is making a very high grade of I. X. L. weather-proof wire. This wire has been in great demand by users of insulated wire, and the company's factory is taxed to its utmost in filling the orders now on hand.

H. C. ROBERTS & COMPANY, 831 Arch street, Philadelphia, Pa., reports the usual heavy Fall business done by this company. It has recently added many new specialties and articles to its stock and is prepared to handle orders for all sorts of electrical supplies and apparatus.

THE WHEELER REFLECTOR COMPANY, 100 Purchase street, Boston, Mass., has added several new shapes and designs in its widely-known reflectors. The company is manufacturing a very high-grade style of tin shades which is giving much satisfaction throughout the field.

LOUIS M. PIGNOLET, 78 Cortlandt street, New York, is placing on the market a line of pocket size voltmeters, ammeters and volt-ammeters for testing storage and primary batteries. These instruments are in various ranges up to 50 volts and 20 amperes for continuous-current measurements.

THE AMERICAN ENDOSCOPIC COMPANY, Providence, R. I., has issued a new catalogue describing its extensive line of high-grade decorative and miniature incandescent lamps. This company has been especially successful in its chosen line of work and can supply miniature lamps for any service.

THE MERIDEN MACHINE TOOL COMPANY, Meriden, Ct., is sending out an unusually attractive booklet entitled "They All Do It." The booklet shows in a striking manner several examples of different styles of advertising, all referring, however, to the forming lathes which are manufactured by this company.

THE WESTERN ELECTRIC COMPANY, Chicago, has just published a 150-page electric fixture catalogue, containing a very complete line of stationary and adjustable fixtures, reflectors, metal and glass shades. A large stock of this material is constantly on hand and the company is prepared to make prompt delivery.

THE CROWN WOVEN WIRE BRUSH COMPANY, Salem, Mass., announces that it is in receipt of several letters from firms who have tried its Crown commutator compound, stating that they have found it preeminently satisfactory whenever used, and that it is also extremely free from gritty and similar harmful substances.

FRED M. LOCKE, Victor, N. Y., is manufacturing a great many of the Victor type of Locke porcelain insulator No. 307. This insulator is guaranteed to work on a voltage of 40,000 and is tested to a voltage of 80,000 before shipment. It is approved by well-known engineers for its electrical and mechanical strength and design.

F. B. SAGE & BROTHER are the successors to the American Electric Specialty Company, 123 Liberty street, New York. This company manufactures a direct-reading ohmmeter which is being generally used, and it is also sales agent for electrical instruments and rheostats, brushes, automatic switching devices and special electrical machinery.

THE FARR TELEPHONE AND CONSTRUCTION SUPPLY COMPANY, Chicago, Ill., has just gotten from the press a voluminous catalogue of telephones, switchboards and telephone supplies and specialties. The catalogue has 333 illustrations and is fully and carefully compiled as to descriptive matter and general information as to modern telephone equipment.

GARL ELECTRIC COMPANY, Akron, Ohio, is installing many of its interior telephone systems throughout the large factories and mills in the country. This interior system of telephone apparatus is becoming daily more popular, and whereas the manufacturer or owner of a large plant, formerly considered it a luxury, he now considers it almost a business necessity.

THE EUREKA ELECTRIC COMPANY, Chicago, desires to announce that it has now in press its new "20th Century" catalogue. This catalogue will be one of the most exhaustive catalogues issued in the independent telephone field. It will contain illustrations of all the well-known Eureka apparatus, as well as a large number of new and improved up-to-date "20th Century" idea devices. The catalogue will be sent on request.

TUCKER MANUFACTURING COMPANY, York, Pa., announces that the great care it always uses in the manufacturing and assembling of its telephone apparatus has caused it to be much appreciated by the most particular of telephone users. The company states that it never allows an instrument to leave its factory until it is thoroughly tried and tested in all of its parts. It has received a large number of orders for its apparatus.

BUNNELL TELEGRAPHIC AND ELECTRICAL COMPANY, 110-116 Beekman street, New York city, is placing on the market a telephone battery, called the Beekman battery. The company guarantees this battery to be strictly high grade, and of extremely long life. The Bunnell Company is continually adding to its stock of telegraph, railway, telephone and electrical supplies and is prepared to handle all and any orders received for such apparatus.

O. C. WHITE COMPANY, Worcester, Mass., is at present very busy equipping several large establishments with its standard adjustable fixtures. These fixtures are particularly advantageous to those finding it necessary to move incandescent lamps from one place to another, and they are so adjusted that they can be satisfactorily used to light the darkest corner of a stock room and remain in the position put while stock is being selected or stored.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has just issued from its own press a beautiful catalogue entitled "Electric Mine Locomotives." The quality of the catalogue in every respect is of the most excellent character, the illustrations being remarkably fine examples of half-tone printing. The catalogue describes a complete line of locomotives and apparatus for mine work and may be had free on application to the General Electric Company.

THE TELEPHONE TRANSMITTER of the Herald Transmitter Company, 42-48 East Twentieth street, New York city, is attracting considerable attention in the telephone field on account of its lightness and handsome appearance. This transmitter is manufactured of aluminum and can be made to fit any support, and can also be constructed with a mouth-piece if desired. The company claims that it requires the smallest amount of current as it is moisture-proof and hermetically sealed, thereby making it free from all side tones.

ROSSITER, MACGOVERN & COMPANY, 141 Broadway, New York city, have issued a very handsome new catalogue of electrical machinery which they have on hand for sale. The company makes the point that it deals only in high-class machinery of recognized merit. It makes a specialty of buying and selling electrical apparatus of all sorts and also operates a repair department. Mr. Charles E. Dustin, who is well known to the electrical fraternity, has assumed the presidency of Rossiter, MacGovern & Company.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, Cleveland, Ohio, has recently closed a contract for the installation of a telephone exchange of 1,000 subscribers at Hornellsville, N. Y. The exchange will be equipped with "Century" apparatus and the construction department of this company will execute all the work of installation. Mr. G. B. Hubbell, well known in telephone engineering fields, is president of the Century Telephone Construction Company, and the company is well organized for both the manufacturing of apparatus and the construction of exchanges.

I. P. FRINK, 551 Pearl Street, New York, is meeting with great success with his window reflector, which is now being used in many of the stores and buildings in the country where the system of window lighting plays an extremely important part. The light is so arranged in the store window that it gives the same effect as a light cast upon the stage, distinctly lighting up each article within range of its focus. Mr. Frank Spencer, general manager of the I. P. Frink Company, states that larger numbers of orders than ever before have been received for this reflector, showing the appreciation with which it is received by the trade.

THE NORTON ELECTRICAL INSTRUMENT COMPANY, Manchester, Ct., has issued a complete price list of Norton voltmeters and ammeters for direct-current circuits. In presenting the list of quotations the following announcement is made: "Recent improvements in these ammeters and voltmeters bring them to the front as switchboard movements. After being once calibrated, they never change, as do the permanent magnet type where the magnets weaken. The instruments are adjusted so that the scale divisions are longest where they will be most used in order to give the greatest possible deflection for a given variation."

DE DION-BOUTON MOTORETTE COMPANY, Church Lane and Thirty-seventh street, Brooklyn, N. Y., has recently attracted considerable attention to its vehicles by winning races at the different automobile meets held throughout the country. The vehicle is one of the handsomest automobiles on the market, and its chief advantage lies in the fact that its machinery is very compact and most easily operated. The company has combined strength and lightness in the manufacture of its vehicles and claims that there is an absence of oil and dirt connected with its operation; moreover, the vehicle is claimed to be absolutely safe and can be easily operated by even the least experienced persons.

THE SIMPLEX ELECTRICAL COMPANY, Cambridgeport, Mass., has recently issued a very complete catalogue of its electric heating specialties. The catalogue contains fifty odd pages profusely illustrated showing the designs of all kinds of electric heating apparatus. Especially noticeable is the illustration showing an electrically equipped kitchen containing a complete line of cooking utensils illustrating the facilities for preparing a meal for 30 persons. It contains an oven, broilers, several heaters for boiling, and other arrangements for keeping plates, etc., warm while the meal is in preparation. The company has recently installed several of its irons in the laundry department of the Hotel Essex, Boston, Mass.